Endoscopist Specialty Is Associated With Incident Colorectal Cancer After a Negative Colonoscopy

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BACKGROUND & AIMS: The incidence of colorectal cancer (CRC) is reduced for at least 10 years after a negative colonoscopy, compared with the general population. However, CRCs do occur in individuals after a negative colonoscopy. We investigated whether the colonoscopy volume and specialty of the endoscopists who perform the exam are associated with CRC after a negative complete colonoscopy. **METHODS:** A cohort of Ontario residents, 50–80 years old, who had a negative complete colonoscopy between January 1, 1992, and December 31, 1997, was identified by using linked administrative databases. Cohort members had no history of CRC or inflammatory bowel disease or a recent colonic resection. Each individual was followed through December 31, 2006, and those with a new diagnosis of CRC were identified. Multivariable analysis was used to evaluate the association of patient, endoscopist, and procedure setting characteristics with incident CRC. **RESULTS:** A cohort of 110,402 individuals with a negative complete colonoscopy was identified; the majority (86%) had their procedures performed in hospitals. During the 15-year follow-up period, 1596 (14.5%) developed CRC. There was no association between endoscopist colonoscopy volume and incident CRC. Among persons who had their colonoscopies at a hospital, those who had their procedures performed by a non-gastroenterologist were at significantly increased risk for developing subsequent CRC. **CONCLUSIONS: Endoscopist specialty is an important determinant of the effectiveness of colonoscopy in usual clinical practice. After a negative colonoscopy, those who have had their procedures performed by a gastroenterologist are less likely to develop CRC.**

Keywords: Endoscopist; Colonoscopy; Colorectal Cancer.

Colonoscopy is endorsed as an option for colorectal cancer (CRC) screening by the US Multi-Society Task Force on Colorectal Cancer and the US Preventive Services Task Force.[1,2] Colonoscopy is considered to be the gold standard for detecting and removing adenomas, and colonoscopic polypectomy is associated with a reduced incidence of CRC.[3] Two large population-based studies have reported that the risk of incident CRC after a negative colonoscopy was reduced for at least 10 years, compared with the general population.[4,5] However, a small but clinically meaningful number of incident CRCs occur after negative colonoscopy. Several factors have been proposed that might explain these incident CRCs, including missed lesions as a result of poor bowel preparation or suboptimal colonoscopy technique, incomplete polypectomy, and new CRCs that might arise after a truly negative colonoscopy.[6] However, the issue of whether endoscopist characteristics, including colonoscopy volume and specialty, are important in this context has not been previously addressed in a large-scale population-based study that reflects usual clinical practice.

The objective of this research was to determine whether endoscopist colonoscopy volume and specialty are associated with incident CRC after a negative complete colonoscopy in usual clinical practice.

Methods

Data Sources

Data for this population-based cohort study were obtained from 4 data sources: the Canadian Institute for Health Information (CIHI), discharge abstract and same-day surgety database, the Ontario Health Insurance Plan (OHIP) database, the Registered Persons Database (RPDB), and the Ontario Cancer Registry (OCR).

The CIHI databases contain information for all acute care facilities about all discharges and procedures done during admission for residents of Ontario since April 1, 1988. All diagnostic codes are recorded according to the International Classification of Diseases-ninth revision-Clinical Modification (ICD-9-CM)[7] from April 1, 1988, to March 31, 2002.

The OHIP database contains information about all claims for physicians' services provided to Ontario residents since January 1, 1991.

The RPDB contains the vital status, age, sex, and location of residence for each person with a valid OHIP health card in Ontario.

The OCR records all cancer diagnoses in Ontario residents since 1964. More than 95% of pathology reports relating to cancer in Ontario are received by the OCR.[8] Each person in Ontario has a health card number (HCN). Because the same HCN is used to identify an individual in all databases, we used the HCN to create a longitudinal record for each person.

Abbreviations used in this paper: CI, confidence interval; CIHI, Canadian Institute for Health Information; CRC, colorectal cancer; HCN, health card number; HR, hazard ratio; ICD-9-CM, International Classification of Diseases-ninth revision-Clinical Modification; OCR, Ontario Cancer Registry; OHIP, Ontario Health Insurance Plan; RPDB, Registered Persons Database.

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The study was approved by the Research Ethics Board of Sunnybrook Health Sciences Centre in Toronto, Ontario, Canada.

Defining the Study Cohort

The parent study for this research was a cohort of 110,402 individuals who had a negative complete colonoscopy.[5] Briefly, we identified all residents of Ontario aged 50–80 years who underwent a complete colonoscopy that was negative between January 1, 1992, and December 31, 1997. We defined a complete colonoscopy by using OHIP procedure code Z555 (insertion of colonoscope to descending colon) plus either procedure code E747 (insertion of colonoscope to cecum) or procedure code E705 (insertion of colonoscope to terminal ileum) (Table 1).[9,10] We defined the first complete colonoscopy as the index colonoscopy. The index colonoscopy was defined as negative when a colorectal biopsy or a polypectomy was not performed on the date of the colonoscopy, a second colonoscopy was not performed within 6 months, and the person was not diagnosed with CRC within 6 months.

We excluded those with a prior diagnosis of CRC recorded in the OCR. On the basis of information recorded in CIHI, we excluded individuals with a prior diagnosis of inflammatory bowel disease (ICD-9-CM codes 555.x, 556.x) and those who had undergone a colonic resection within 5 years before the index colonoscopy. We also excluded individuals who lived in the South East Local Health Integration Network, a geographic region of Ontario in which physician reimbursement is through an alternate funding plan and therefore claims for services are not recorded in OHIP. The remaining persons comprised the study cohort.

Identifying Incident Colorectal Cancers

We identified all CRCs (Table 2) through December 31, 2006, for the study cohort. Follow-up began on the date of the index colonoscopy. During follow-up we removed individuals from the study cohort if they developed CRC, moved out of the province, or died.

Explaining Incident Colorectal Cancers

We examined patient, endoscopist, and procedure setting characteristics associated with incident CRC. The patient characteristics examined were age, sex, and comorbidity. Comorbidity was assessed with the Deyo score calculated from ICD-9-CM diagnoses other than CRC recorded in CIHI for 5 years before the index colonoscopy.[11]

The endoscopist characteristics examined were endoscopist colonoscopy volume and endoscopist specialty. Endoscopist colonoscopy volume was defined by using the total number of colonoscopies performed during the study period (1992–1997) and calculating the average annual volume for each physician. At the index colonoscopy, individuals were assigned to the volume quintile of the endoscopist who performed the procedure.

Endoscopist specialty was classified as Gastroenterology, General Surgery, or "Other" as recorded in OHIP. A majority of endoscopists in the "Other" category were classified as Internal Medicine (95.4%); a few (1.9%) were classified as Family Practice or General Practice. Most general surgery trainees have 2 months of dedicated endoscopy training in their programs. Gastroenterology trainees have dedicated endoscopy training for a minimum of 16 months during their programs.

We also examined where the colonoscopy was done (academic hospital, community hospital, private office/clinic). We classified a procedure as private office/clinic if either the associated code, E749 (Table 1), was recorded in the OHIP database, or if no overlapping admission was recorded in the CIHI database on the date of the index colonoscopy. For procedures done in a hospital or a hospital-based same-day surgery unit, we used the associated facility code recorded in the CIHI and OHIP databases to identify the hospital in which the procedure was done. Because 14 of the 176 acute care hospitals in Ontario are designated as teaching hospitals, a colonoscopy done in a teaching hospital was classified as being done in an academic hospital.

Table 1. OHIP Procedure Codes

OHIP procedure code	Procedure
Z555	Colonoscopy to descending colon
Z555+E740	Colonoscopy to splenic flexure
Z555+E740+E741	Colonoscopy to hepatic flexure
Z555+E740+E741+E747	Colonoscopy to cecum
Z555+E740+E741+E747+E705	Colonoscopy to terminal ileum
E749	Endoscopy at an independent facility

Table 2. ICD-9-CM Diagnosis Codes for CRC

ICD-9-CM code	ICD-9-CM diagnosis
153.0	CRC hepatic flexure
153.1	CRC transverse colon
153.2	CRC descending colon
153.3	CRC sigmoid colon
153.4	CRC cecum (ileocecal valve)
153.6	CRC ascending colon
153.7	CRC splenic flexure
153.8	CRC other specific site
153.9	CRC colon unspecified
154.0	CRC rectosigmoid junction
154.1	CRC rectum

Data Analysis

Data analysis was conducted by using SAS Version 9.13 (SAS Institute Inc, Cary, NC). Univariate tests of association were done with t tests for continuous variables and χ^2 tests for categorical variables. We evaluated interactions between endoscopist colonoscopy volume, endoscopist specialty, and procedure setting. There was evidence of an interaction between endoscopist volume and procedure setting. To address this, we used separate Cox proportional hazards models for hospital and private office/clinic settings. Hazard ratios (HRs) with 95% confidence intervals (CIs) and their associated P values were calculated for incident CRC, after adjustment for age, sex, comorbidity, endoscopist colonoscopy volume, and endoscopist specialty. A P value of .05 or less was considered significant.

Results

From January 1, 1992, to December 31, 1997, we identified 110,402 individuals who had a negative complete

Table 3. Baseline Characteristics of Negative Complete Colonoscopy Cohort, by Colonoscopy Setting

Characteristic	Overall (N = 110,402) N (%)	Private office (N = 15,286) N (%)	Hospital (N = 95,116) N (%)	*P* value
Age (y)				
50–69	41,175 (37.3)	6655 (43.5)	34,520 (36.3)	<.0001
60–69	39,880 (36.1)	5559 (36.4)	34,321 (36.1)	
70–80	29,347 (26.6)	3072 (20.1)	26,275 (27.6)	
Sex				
Female	60,960 (55.2)	7326 (47.9)	53,634 (56.4)	<.0001
Male	49,442 (44.8)	7960 (52.1)	41,482 (43.6)	
Comorbidity (Deyo score)				
0	105,020 (95.1)	14,822 (97.0)	90,198 (94.8)	<.0001
1	3132 (2.9)	257 (1.7)	2875 (3.0)	
2	1587 (1.4)	154 (1.0)	1433 (1.5)	
≥3	663 (0.6)	53 (0.3)	610 (0.6)	
Mean annual endoscopist colonoscopy volume (minimum–maximum)				
1 (1–154)	22,182 (20.1)	1680 (11.0)	20,502 (21.5)	<.0001
2 (155–256)	22,072 (20.0)	1604 (10.5)	20,468 (21.5)	
3 (257–370)	21,901 (19.8)	2392 (15.6)	19,509 (20.5)	
4 (371–507)	22,361 (20.3)	1847 (12.1)	20,514 (21.6)	
5 (508–1102)	21,886 (19.8)	7763 (50.8)	14,123 (14.9)	
Endoscopist specialty				
Gastroenterology	17,718 (16.0)	1245 (8.1)	16,473 (17.3)	<.0001
General surgery	44,930 (40.7)	8811 (57.7)	36,119 (38.0)	
Other	47,754 (43.3)	5230 (34.2)	42,524 (44.7)	

colonoscopy. Table 3 shows the characteristics of the study cohort. The majority of individuals (86%) had their colonoscopy in a hospital. Compared with those who had their procedures done in a hospital, individuals who had their colonoscopies in private office/clinics were younger, more likely to be men, have less comorbidity, more likely to have their procedure done by an endoscopist in the highest volume quintile, and more likely to have their procedure performed by a general surgeon.

During the 15-year follow-up period, CRC was diagnosed in 1596 persons, of whom 1426 had the index colonoscopy in a hospital, and 170 had the procedure in a private office/clinic.

Table 4 shows the results of the multivariable analyses for the association of endoscopist colonoscopy volume and endoscopist specialty and incident CRC, adjusted for patient age, sex, and comorbidity. For those individuals who had colonoscopies done in a hospital, having the procedure performed by a non-gastroenterologist was associated with a statistically significant increased risk of incident CRC. For example, for those who had their procedures performed by a general surgeon, the risk of incident CRC was increased by almost 40% (HR, 1.389; 95% CI, 1.157–1.667), compared with those who had their procedures performed by a gastroenterologist. There was no association between endoscopist volume and incident CRC in either setting, after adjusting for patient age, sex, and comorbidity.

Discussion

We report here the results of a population-based cohort study of 110,402 people age 50–80 years who had a negative complete colonoscopy during 1992 to 1997 and were followed

Table 4. Results of Cox Proportional Hazards Models Evaluating the Association of Endoscopist Colonoscopy Volume and Endoscopy Specialty and Incident CRC After Negative Colonoscopy Among Persons 50–80 Years of Age in Ontario in 1992–1997 and Followed Through 2006

Characteristic	Private office/clinic (N = 15,286)		Hospital (N = 95,116)	
	HR[a] (95% CI)	*P* value	HR[a] (95% CI)	*P* value
Mean annual endoscopist colonoscopy volume				
1 (low)	1.599 (0.958–2.669)	.0725	1.162 (0.948–1.425)	.1476
2	1.391 (0.839–2.306)	.2011	1.082 (0.881–1.327)	.4528
3	1.142 (0.756–1.723)	.5284	0.947 (0.778–1.153)	.5884
4	1.148 (0.671–1.967)	.6141	1.094 (0.853–1.282)	.6811
5 (high)	1.000		1.000	
Endoscopist specialty				
Gastroenterology	1.000		1.000	
General surgery	1.189 (0.613–2.308)	.6091	1.389 (1.157–1.667)	.0004
Other	0.842 (0.442–1.604)	.6008	1.275 (1.078–1.509)	.0046

[a]Adjusted for patient age, sex, and comorbidity.

for up to 15 years. For those individuals who underwent their colonoscopies in a hospital, which was the majority (86%), having the procedure performed by a non-gastroenterologist was independently associated with subsequent incident CRC. For those who underwent their colonoscopies in a private office/clinic, endoscopist specialty was not significantly associated with incident CRC. The latter finding might be due to the lack of variability in endoscopy specialty in the private office/clinics, in which only 14% of procedures were performed, and in which only 8.1% of procedures were performed by a gastroenterologist.

Previous population-based studies have focused on estimating the magnitude and duration of the reduction in incident CRC after a negative colonoscopy. A population-based cohort study of 39,375 individuals of all ages from Manitoba reported that negative colonoscopy was associated with a standardized incidence ratio for CRC of 0.28 (95% CI, 0.09–0.65) at 10 years.[4] In the parent study to the current research, we reported that negative complete colonoscopy was associated with a subsequent reduced incidence of CRC overall during a 14-year follow-up period.[5] Taken together, these studies showed the reduction in CRC incidence is sustained for at least 10 years.

Few studies have evaluated factors associated with incident CRC after negative colonoscopy, in part because this outcome is relatively uncommon, which means that a large study cohort is required. The Manitoba study[4] reported a nonsignificant trend toward general practitioners performing a higher proportion of the colonoscopies in persons with a subsequent incident CRC. In a previous population-based study of 12,487 persons with a new diagnosis of CRC who had a normal colonoscopy within 3 years before their diagnosis, we reported that compared with having the colonoscopy performed by a gastroenterologist, having the procedure performed by an internist or family physician was independently associated with new or missed CRC.[9] The findings reported here confirm and extend this prior work. A US study done at 20 Indiana hospitals, in which 47 (5%) of 941 patients who had a normal colonoscopy within 3 years before their diagnosis of CRC, reported that the risk of missed CRC was higher for non-gastroenterologists compared with gastroenterologists.[12]

The results from this study add to the body of evidence that, in general, among those physicians who perform colonoscopy in the hospital setting, gastroenterologists are more proficient at colonoscopy than other physicians, including general surgeons. This might reflect the considerable formal training in endoscopy that forms part of gastroenterology core training requirements in Canada and in the US. Considering the large costs associated with the delivery of colonoscopies, it is important that the practice of colonoscopy is skilled and effective. Patients who had their procedures in a private office/clinic were younger, more likely to be men, and have less comorbidity compared with those who had their colonoscopies in the hospital. It is likely that the procedures in the private office/clinics were technically easier to perform. This might explain why we observed an association between endoscopist specialty and outcome in the hospital. Having extensive formal training matters more when the procedures are more challenging to perform.

The results reported here must be interpreted in light of the strengths and weaknesses of the study. First, a population-based study reduces the selection bias that can occur when patients are enrolled only from centers with experts in colonoscopy. Second, coding errors might result in misclassification. Previous validation studies of health care administrative databases in Ontario have shown that procedures and diagnoses are generally accurately coded.[13] Third, we could not distinguish screening from diagnostic colonoscopies and could not identify patient characteristics such as family history or symptoms. Our results might therefore not reflect the findings in an average-risk population. Nonetheless, the findings reported here are applicable to persons 50–80 years of age who undergo colonoscopy, regardless of indication. Fourth, there might be differences in risk factors for CRC among the patients who underwent colonoscopy performed by the 3 categories of endoscopist specialists. We do not have sufficient clinical information to know whether this is the case. Finally, because of changes in colonoscopy practice, the study results might not pertain to the current era. However, there has been no change in endoscopy training requirements since the study period. In addition, the proportion of colonoscopies performed by gastroenterologists has increased only modestly (to 26% in 2008).

In conclusion, our large population-based cohort study of 50- to 80-year-olds who had a negative complete colonoscopy has demonstrated that those who had their colonoscopy in a hospital and had the procedure performed by a non-gastroenterologist were at a significant increased risk of subsequent incident CRC. These results highlight the importance of endoscopist specialty in the performance of colonoscopy in usual clinical practice.

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Reprint requests

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Conflicts of interest

The authors disclose no conflicts.