Factors associated with colorectal cancer occurrence after colonoscopy that did not diagnose colorectal cancer

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Background and Aims: Up to 6% of colorectal cancers (CRCs) are diagnosed within 5 years of a colonoscopy that did not diagnose CRC (post-colonoscopy colorectal cancer, PCCRC). PCCRC and associated risk factors were examined within a national hospital episode database.

Methods: A retrospective case-control study of all colonoscopies performed on adults recorded in Hospital Episode Statistics (HES) between 2003 and 2009 in England. PCCRC cases underwent colonoscopy 6 to 60 months before diagnosis; controls had not undergone colonoscopy 6 to 60 months before diagnosis. Multivariate logistic regression analysis examined associations with PCCRC.

Results: A total of 1,439,684 colonoscopies were analyzed, including 67,202 cases of CRC and 8147 cases of PCCRC (12.1%). Multivariate analysis revealed that female sex (odds ratio [OR], 1.13; 95% confidence interval [CI], 1.08–1.19; $P < .001$), older age (70–74 years) (OR, 1.09; 95% CI, 1.00–1.18; $P = .039$), increased comorbidity (Charlson index 5+) (OR, 1.16; 95% CI, 1.05–1.28; $P < .003$), and CRC of the right side of the colon (OR, 1.17; 95% CI, 1.11–1.23; $P < .0001$) were associated with PCCRC. Emergency colonoscopy (OR, 0.54; 95% CI, 0.59–0.69; $P < .0001$) was negatively associated with PCCRC. More individuals with PCCRC developed metastases within 12 months and fewer underwent surgery (OR, 0.33; 95% CI, 0.32–0.35; $P < .0001$) or chemotherapy (OR, 0.66; 95% CI, 0.62–0.69), $P < .0001$). PCCRC rates varied 2-fold between providers and PCCRC was associated with medium-volume providers compared with high-volume providers (OR, 1.13; 95% CI, 1.01–1.27; $P = .035$). The PCCRC rate fell from 13.8% in 2003 to 11.9% in 2009.

Conclusions: PCCRC occurred in 12.1% of patients with CRC between 2003 and 2009. PCCRC was associated with female sex, older age, increased comorbidity, CRC of the right side of the colon, elective procedures, and colonoscopy volume. PCCRC was associated with worse outcomes. (Gastrointest Endosc 2016;84:287-95.)

INTRODUCTION

Colonoscopy is the criterion standard for diagnosing, screening, and surveillance for CRC. In England, the setting of national standards for colonoscopy and accreditation of endoscopy units has resulted in an improvement in auditable colonoscopy standards over the last decade.[1] The same period has also coincided with an increase in 5-year survival after CRC diagnosis from 47.8% to 53.6%.[2] However, 2.6% to 6.0% of patients with CRC have previously been reported to be diagnosed within 5 years of a colonoscopy that did not detect cancer. This event is termed post-colonoscopy colorectal cancer (PCCRC).[3-5] It has been proposed that PCCRC may have a different cell biology from other CRCs with more aggressive and rapidly growing tumors.[6,7] However, 2 recently published North American studies concluded that this did not apply to the majority of cases of PCCRC, with around two thirds of cases of PCCRC a result of missed lesions or incomplete polypectomy.[4,8]

Abbreviations: BCSP, bowel cancer screening program; CRC, colorectal cancer; HES, Hospital Episode Statistics; ICD-10, International Classification of Diseases version 10; NCIN, National Cancer Intelligence Network; NHS, National Health Service; ONS, Office for National Statistics; OPCS-4, Office of Population Censuses and Surveys Classification of Interventions and Procedures 4th revision; PCCRC, post-colonoscopy colorectal cancer; UHB, University Hospital Birmingham.

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Given the improvements in colonoscopy over the past decade in England, we have examined the impact on PCCRC in a national hospital episode database and associated risk factors for these events.

METHODS

Data sources

Hospital Episode Statistics (HES) is an administrative database that records information on all elective and emergency care episodes in National Health Service (NHS) hospitals in England.[9] Each care episode record includes data on demographics, admission, diagnoses, and procedures. Diagnoses are coded using the International Classification of Diseases version 10 (ICD-10) and procedures are coded using the Office of Population Censuses and Surveys Classification of Interventions and Procedures 4th revision (OPCS-4). HES is linked to Office for National Statistics (ONS) mortality records, which include date of death and causes of death recorded on death certificates. The NHS provides comprehensive healthcare coverage for the UK population, with the majority of colonoscopies performed in the United Kingdom by an NHS provider.[1]

Subject definitions

All individuals more than 18 years of age undergoing colonoscopy between April 2003 and March 2009 were identified from HES. Colonoscopy and CRC were defined by OPCS-4 (Appendix 1, available online at www.giejournal.org) and ICD-10 codes (Appendix 2, available online at www.giejournal.org), respectively. Individuals with a CRC diagnosis before the first episode of colonoscopy and those with a diagnosis of inflammatory bowel disease were excluded from the analysis to avoid confounding through surveillance.

Recording of a CRC diagnosis in HES records may be delayed by a few weeks from the date of the diagnostic colonoscopy code.[10,11] For the purpose of this study, the diagnosis date was therefore defined as the first colonoscopy code during the 6 months before the first CRC coding episode in HES or mortality records,[10,12] or the first CRC episode for those individuals who did not have a colonoscopy during this 6-month period because they were diagnosed through an alternative method (eg, barium enema, CT colonography, or flexible sigmoidoscopy). Individuals undergoing colonoscopy 6 to 60 months before a subsequent CRC diagnosis were identified as PCCRC cases. These cases were further classified as PCCRC 6 to 12 months (colonoscopy 6–12 months before CRC diagnosis); PCCRC 12 to 36 months (colonoscopy 12–36 months before CRC diagnosis), and PCCRC 36 to 60 months (colonoscopy 36–60 months before CRC diagnosis). For patients who had more than 1 colonoscopy 6 to 60 months before CRC diagnosis, data from the most recent colonoscopy were used for analysis. Controls were individuals who had not undergone colonoscopy in the period 6 to 60 months before CRC diagnosis. Colonoscopies from 2003 to 2009 were studied to ensure all individuals had at least 5 years of follow-up within HES. The PCCRC rate was calculated from the number of PCCRC cases divided by the sum of PCCRC cases and controls.[13]

Validation of colonoscopy and colorectal cancer populations

To assess the validity of the HES colonoscopy population, the number of colonoscopies between 2007 and 2010 at University Hospital Birmingham (UHB) was extracted from endoscopy records (Unisoft Medical Systems, Enfield, Middlesex, UK) and compared with the number of colonoscopies recorded in HES for UHB. To assess the validity of a CRC diagnosis in HES using the study methodology, the number of HES CRC cases was compared with the number of CRC cases diagnosed in England from the National Cancer Intelligence Network (NCIN)[14] from 2002 to 2011. Finally, the rate of surgery in the HES CRC population was compared with the rate of surgery in the National Bowel Cancer Audit between 2008 and 2011.[15-17]

Study variables

Subject demographics. Study variables were extracted from coding at the time of PCCRC colonoscopy in cases and diagnostic colonoscopy or first CRC episode in controls. Ethnicity was identified from HES demographic fields and grouped into white or white British, Asian or Asian British, black or black British, Chinese, mixed, and other ethnic groups.

Comorbidity. The Charlson comorbidity index was calculated using ICD-10 codes for secondary diagnoses, excluding metastatic disease, and divided into 3 categories: 0 (no comorbidity), 1 to 4 (low comorbidity), and 5 or greater (high comorbidity).[18]

Socioeconomic status. Deprivation was assessed using the Index of Multiple Deprivations 2007, which is an aggregate score for each English catchment area. Individuals were linked to their corresponding catchment area by postcode of residence and associations with deprivation were analyzed in quintiles, with quintile 1 being the most deprived.

Colorectal cancer variables. CRC site was classified based on the first CRC coding episode into right side of the colon, left side of the colon, and unspecified (Appendix 3, available online at www.giejournal.org). Coding of cases initially recorded as unspecified site was examined to check if a more specific code was used subsequently; this was then used to determine the CRC site. Colonic polyps were identified from ICD-10 codes (Appendix 4, available online at www.giejournal.org).

Distant metastases were identified by ICD-10 codes (Appendix 5, available online at www.giejournal.org) up to 12 months from diagnosis date and were used as a