THERAPEUTIC ADVANCES in
Gastrointestinal Endoscopy

Original Research

Serrated polyp detection rate in colonoscopies performed by gastrointestinal fellows

Ther Adv Gastrointest Endosc

2022, Vol. 15: 1–6

DOI: 10.1177/26317745221136775

Matthew Heckroth, Michael Eiswerth, Mohamed Elmasry, Khushboo Gala, Wenjing Cai, Scott Diamond, Amal Shine, David Liu, Nanlong Liu, Sudaraka Tholkage, Maiying Kong and Dipendra Parajuli

Abstract

Background: Clinically significant serrated polyp detection rate (CSSDR) and proximal serrated polyp detection rate (PSDR) have been suggested as the potential quality benchmarks for colonoscopy (CSSDR = 7% and PSDR = 11%) in comparison to the established benchmark adenoma detection rate (ADR). Another emerging milestone is the detection rate of lateral spreading lesions (LSLs).

Objectives: This study aimed to evaluate CSSDR, PSDR, ADR, and LSL detection rates among gastrointestinal (GI) fellows performing a colonoscopy. A secondary aim was to evaluate patient factors associated with the detection rates of these lesions.

Design and Methods: A retrospective review of 799 colonoscopy reports was performed. GI fellow details, demographic data, and pathology found on colonoscopy were collected. Multiple logistic regression analysis was performed to identify the factors associated with CSSDR, PSDR, ADR, and LSL detection rates. A p value < 0.05 was considered statistically significant.

Results: For our patient population, the median age was 58 years; 396 (49.8%) were male and 386 (48.6%) were African American. The 15 GI fellows ranged from first (F1), second (F2), or third (F3) year of training. We found an overall CSSDR of 4.4%, PSDR of 10.5%, ADR of 42.1%, and LSL detection rate of 3.2%. Female gender was associated with CSSDR, while only age was associated with PSDR. GI fellow level of training was associated with LSL detection rate, with the odds of detecting them expected to be four times higher in F2/F3s than F1s.

Conclusion: Although GI fellows demonstrated an above-recommended ADR and nearly reached target PSDR, they failed to achieve target CSSDR. Future studies investigating a benchmark for LSL detection rate are needed to quantify if GI fellows are detecting these lesions at adequate rates.

Keywords: adenoma, colonoscopy, fellow, polyp, serrated

Received: 8 December 2021; revised manuscript accepted: 17 October 2022.

Correspondence to:
Dipendra Parajuli
Department of Gastroenterology and Hepatology, University of Louisville, 550 S Jackson St, Louisville, KY 40202, USA.
dipendra.parajuli@louisville.edu

Matthew Heckroth
Michael Eiswerth
Mohamed Elmasry
Khushboo Gala
Wenjing Cai
Scott Diamond
Department of Internal Medicine, University of Louisville, Louisville, KY, USA

Amal Shine
Nanlong Liu
Department of Gastroenterology and Hepatology, University of Louisville, Louisville, KY, USA

David Liu
School of Medicine, University of Louisville, Louisville, KY, USA

Sudaraka Tholkage
Maiying Kong
Department of Bioinformatics and Biostatistics, University of Louisville, Louisville, KY, USA

Introduction

Colorectal cancer (CRC) is the third most common cancer and the second leading cause of cancer death in the United States. It is estimated that in 2021, there will be approximately 149,500 newly diagnosed CRC cases with 52,980 deaths.[1] It is also considered one of the most preventable cancers as CRC most often arises from pre-malignant polyps in a multistep process that generally takes 10–15 years.[2] This slow progression allows for early detection of cancer through screening and removal of precancerous polyps, which has led to a significant decrease in overall incidence and mortality over the last three decades.[3]

Multiple testing modalities are approved for CRC screening in the United States, including colonoscopy, flexible sigmoidoscopy, computed

tomography (CT) colonography, fecal immunochemical test (FIT), and stool DNA test. Colonoscopy is generally accepted as the gold standard screening method and is both diagnostic and therapeutic. A recent systematic literature review and meta-analysis showed a 69% reduction in overall CRC incidence and a 68% reduction in mortality associated with screening colonoscopy.[4] However, performing a colonoscopy can be difficult and takes practice and supervision from a trained endoscopist to become proficient.

For a screening colonoscopy to be effective, the bowel preparation must be optimal, and the endoscopist must identify and completely remove precancerous lesions. Due to variation in colonoscopy performance between endoscopists, quality measures are needed to ensure high performance. Adenoma detection rate (ADR) is a widely accepted benchmark on the quality of screening colonoscopy. It is defined as the proportion of patients undergoing average-risk index screening colonoscopy who have one or more adenomas detected.[5] The American Society for Gastrointestinal Endoscopy (ASGE)/American College of Gastroenterology (ACG) Task Force on Quality in Endoscopy has established a goal ADR of greater than 25% in a mixed male–female population (greater than 30% for males and greater than 20% for females).

Serrated polyps, which include sessile serrated adenomas/polyps (SSA/P), traditional serrated adenomas (TSAs), and hyperplastic polyps (HP), are a group of lesions characterized by the 'saw-toothed' histological appearance of their epithelial crypts. They have variable malignant potential, with HPs considered non-neoplastic and SSA/Ps and TSAs both precursors of cancer *via* the serrated pathway. The serrated pathway may account for up to one-third of all CRC.[6] Due to their high malignant potential, SSA/Ps and TSAs need to be accurately diagnosed and removed during colonoscopy, whereas HPs generally do not need to be removed. Serrated polyps may be challenging to detect for various reasons, including their flat morphology and indistinct borders. There are subtle differences between SSA/Ps and HPs on endoscopy that can help differentiate the two. SSA/Ps are often >5 mm in size, frequently covered in a 'mucus cap', difficult to discern from the surrounding mucosa and commonly located in the proximal colon, where bowel prep is more often inadequate.[7] Under magnifying narrow-band imaging (NBI), they have varicose microvascular vessels and expanded crypt openings. In contrast, HPs more often occur in the distal colon and are usually smaller in size.[8]

Due to the variation observed in serrated polyp detection and their malignant potential, clinically significant serrated polyp detection rate (CSSDR) and proximal serrated polyp detection rate (PSDR) have been suggested as potential new benchmarks of adequate colonoscopic examination to prevent CRC (CSSDR of 7% and PSDR of 11%), in addition to ADR. CSSDR is defined as an SSA/P, TSA, or HP greater than 1 cm anywhere in the colon or any HP greater than 5 mm proximal to the sigmoid colon. PSDR is any serrated polyp of any size proximal to the sigmoid colon, regardless of size or histological subtype.[9]

There have been multiple previous studies assessing ADR in gastroenterology (GI) fellows; however, data regarding detection rates of serrated polyps among trainees is lacking. This retrospective study collected data on GI fellows performing colonoscopy and aimed to evaluate the CSSDR, PSDR, and ADR to assess whether trainees experience level had an impact on benchmarks in detecting serrated polyps. In addition, we assessed detection rates of laterally spreading lesions (LSLs), defined as flat polyps that measure 10 millimeters or greater, as these are known to be easily missed. A secondary aim was to identify patient factors associated with the rates of serrated polyp detection by GI fellows.

Methods

We performed an institution review board (IRB) approved, retrospective analysis of 2082 colonoscopy reports at an urban academic hospital. Of those patients, 1283 were excluded for reasons including poor bowel prep, inpatient diagnostic colonoscopy, prior colon surgery, colonoscopy performed by multiple GI fellows or an attending physician only, or missing pathology report, leaving 799 in our analysis. Data were collected on 15 GI fellows who were in their first (F1), second (F2), or third (F3) year of training. Patient demographic data, GI fellow training details, and pathology results were recorded. Of the 799 patients in the original data set, there were missing values in each variable we considered, removed for statistical analysis (Supplemental Table 1). ADR, CSSDR, PSDR, and LSL detection rates were calculated by dividing the number

of colonoscopies containing these lesions by the total number of colonoscopies performed for each fellow. Continuous variables were summarized using median values and interquartile ranges, and categorical variables were summarized using frequencies and percentages. Multiple logistic regression analysis was performed to examine the factors associated with ADR, CSSDR, PSDR, and LSL detection rates. The stepwise variable selection method removed unimportant variables and obtained the parsimonious models for final statistical inferences. A p value <0.05 was considered statistically significant.

The reporting of this study conforms to the STROBE statement.[10]

Results

The median age was 58 years for our patient population, with 83.2% over 50 years old. 396 (49.8%) were male, 399 (50.2%) were female, 368 (46.3%) Caucasian, 386 (48.6%) African American and 40 (5%) Other (Supplemental Table 2). Of the colonoscopies performed, 218 (27.3%) were done by F1s, 373 (46.7%) by F2s, and 207 (25.9%) by F3s (Supplemental Table 3). We found an overall CSSDR of 4.4%, PSDR of 10.5%, ADR of 42.1% (48.6% in males, 36.7% in females), and LSL detection rate of 3.2% in our practice (Supplemental Table 4).

Using logistic regression modeling, we found that female gender (odds ratio [OR] = 2.17, $p=0.042$) and age (OR = 1.36, $p=0.092$, significant at 10% level of significance) were significantly associated with the CSSDR. The odds of detecting clinically significant serrated polyps are approximately twice as high in female patients than males. In comparison, only patient age was significantly associated with the PSDR (OR = 1.34, $p=0.015$). When the age increased by 10 years, we expect the odds of detecting clinically significant serrated polyps to increase by 36.3% and proximal serrated polyps to increase by 34.4%.

According to the logistic regression model, patient age and gender are significantly associated with the ADR. The odds of detecting an adenoma are 43.4% lower in female patients compared to males. For every 10-year increase in age, we expect the odds of detecting any adenoma to increase by 64%. At a 10% level of significance, patient age is also associated with the LSL detection rate, with the odds of detecting laterally spreading lesions expected to increase by 48.7% for a 10-year increase in age. We also found that race is also significantly associated with LSL detection rate, with the odds of detecting these lesions about three times higher in Caucasian patients when compared to African American patients.

Between first-year (F1) and upper-level (F2 and F3) GI fellows, there was no statistical difference in CSSDR, PSDR, or ADR. Detection of LSLs, however, showed trend toward significance with 0.9% detection rate in F1s and 4.0% in F2/F3s ($p=0.05$). The odds of detecting LSLs are expected to be four times higher for upper-level fellows compared to first-year fellows (OR = 4.37, $p=0.048$).

Discussion

Traditionally, the ADR has been the primary colonoscopy quality indicator to determine high-quality care.[11] Recent studies suggest no difference in ADR across levels of training in gastroenterology fellowship, making this an inadequate measure of competency for trainees.[12,13] Our study showed similar findings as there was no statistical difference in ADR among F1s and F2/F3. We did find that GI fellows demonstrated an above-recommended ADR of 42.1% (48.6% in males and 36.7% in females), which may be attributed to the direct supervision by an attending physician and increased withdrawal times to help fellows detect adenomas. A retrospective study showed that the ADR was significantly higher among colonoscopies involving a gastroenterology fellow than those performed by gastroenterology attending physicians alone.[14] It is important to note that F1s generally have closer supervision by an attending physician and experienced endoscopy staff than F2/F3s who are often allowed more supervised autonomy. This may explain the lack of difference in ADR between first-year and upper-level fellows.

Since ADR may not be a valuable assessment of colonoscopy competency in GI fellows, other quality metrics may provide information among trainees. To our knowledge, no previous studies have been performed assessing CSSDR and PSDR among GI fellows. We found that the PSDR of 10.5% in GI fellows was comparable to the corresponding metric of 11%; however, the CSSDR of 4.4% did not meet the 7% suggested by previous studies.[9] In contrast to ADR, in which GI fellows exceeded quality measures, trainees did

not meet recommended benchmarks in detecting serrated polyps. This may reflect a lack of knowledge of these lesions in trainees, as well as endoscopy technicians and nurses who assist fellows. A recent retrospective study of patients who had undergone a second colonoscopy within 6 months of their first showed that missed polyps were more frequently located in the right colon, where sessile serrated adenoma/polyps are more commonly located.[15] The serrated pathway accounts for approximately 10% to 30% of newly diagnosed CRC and is responsible for a disproportionate number of interval cancers, which are cancers that occur after a colonoscopy.[16,17] Due to the significant risk of developing CRC if these lesions are missed, it is vital that trainees detect serrated polyps at a target rate. Besides education about these polyps, newer endoscopic tools, such as chromoendoscopy, NBI, water immersion, and artificial intelligence (AI), may improve the detection of serrated polyps and should be implemented into GI fellowship program curriculums.[18–21]

Understanding which patients are at increased risk of developing serrated polyps may help increase their detection rate in trainees. For example, GI fellows may be more diligent in looking for these lesions in patients with certain risk factors. In addition, patients at higher risk may be scheduled in longer procedural slots and attending physicians provide more supervision to fellows performing their colonoscopies. We found that certain patient factors were associated with higher rates of serrated polyp detection. Female gender and age were associated with higher rates of CSSDR, while only age was associated with PSDR. These data are consistent with previous studies that have reported age, smoking, obesity, diabetes, and specific diets associated with serrated polyps. Gender as a risk factor has had mixed results in previous reports. One literature review found that multiple studies showed males have an increased risk of all serrated polyps, while female sex has been associated with SSA/P.[22] We found that overall ADR was also associated with older age. However, in contrast to CSSDR, male sex was a significant risk factor for ADR. Patient factors like gender and age affect CSSDR, PSDR, and ADR, and the effects of patient characteristics on these newer benchmarks need to be further explored.

LSLs are superficial lesions greater than 10 mm in diameter that grow laterally, rather than vertically, along the colonic wall.[23] Nearly one-third of these lesions contain high-grade dysplasia or invasive cancer and are a significant target for screening colonoscopy.[24] Due to their horizontal growth and flat morphology, LSLs are known to be easily missed. Our overall LSL detection rate in this single academic training program was 3.2%, which was lower than detection rates of other polyps. The LSL detection rate was lower in F1s than F2s and F3s, with the odds of detecting these polyps expected to be almost four times higher in senior-level GI fellows than junior first years. The difference in LSL detection rates between GI fellow training years is likely due to more procedural skills, increased exposure and increased awareness of these lesions in senior-level fellows. The detection rate was significantly higher in Caucasian patients compared to African Americans. Further research should be conducted at multiple training programs to elicit if this is a national trend. Future studies investigating a national standard for LSL detection rate would better help understand these data and assess whether trainees are finding these lesions at an adequate rate.

Advances in AI during colonoscopy offer promising methods of increasing the detection rates of these flat polyps. With the ability to process each frame of a colonoscopy video stream and consistently analyze every corner of the screen, AI can detect and alert any suspicious targets that otherwise may be missed.[21] Multiple studies have shown that deep learning computer-aided polyp detection (CADe) significantly increases the ADR compared to conventional colonoscopy.[25,26] While fewer studies have investigated its use in the detection of serrated polyps and LSL's, recent data suggests that AI improves performance in detecting these easy-to-miss lesions, as well.[21,27] If validated, implementing AI-assisted colonoscopy into training program curriculums may improve CSSDR, PSDR, and LSL detection rates and further studies would help to assess its utility.

There are several limitations to this study. First, this was a retrospective analysis, and all data were collected on information in the electronic records. For this reason, some patients characteristics were unavailable. Second, our study included trainees from a single GI fellowship training program, thus the detection rate of certain polyps likely does not represent all GI fellows. Although there is a recommended minimal requirement in the number of colonoscopies performed by trainees during fellowship, there is significant variation in the amount of colonoscopies performed between programs.

Therefore, GI fellows at programs with higher colonoscopy numbers may have more experience and higher detection rates than those with lower numbers. In addition, the amount of supervision by attending physicians likely varies between training programs which may also affect detection rates. Another limitation is that as our study was conducted at a single urban, academic hospital, representation of certain patient populations was limited. One way to eliminate these limitations would be to implement a multicenter study to include a more representative trainee and patient population.

Conclusion

In summary, this study suggests that trainees may not be detecting serrated polyps at the target rate. Although GI fellows demonstrated an above-recommended ADR and nearly reached target PSDR, they failed to achieve target CSSDR. Further multicenter studies are required to evaluate if this is a national trend. In addition, research is needed to investigate a national standard for LSL detection rate to determine if GI fellows adequately detect these lesions.

Declarations

Ethics approval and consent to participate

The Institutional Review Board of the University of Louisville waived the need for ethics approval and the need to obtain consent to participate due to the retrospective nature of this non-interventional study.

Consent for publication

Consent for publication was not required due to the retrospective nature of this non-interventional study.

Author contributions

Matthew Heckroth: Formal analysis; Investigation; Writing – original draft; Writing – review & editing.

Michael Eiswerth: Investigation; Writing – original draft; Writing – review & editing.

Mohamed Elmasry: Investigation; Writing – review & editing.

Khushboo Gala: Investigation; Writing – review & editing.

Wenjing Cai: Investigation; Writing – review & editing.

Scott Diamond: Investigation; Writing – review & editing.

Amal Shine: Investigation; Writing – review & editing.

David Liu: Investigation; Writing – review & editing.

Nanlong Liu: Investigation; Writing – review & editing.

Sudaraka Tholkage: Investigation; Writing – review & editing.

Maiying Kong: Formal analysis; Writing – review & editing.

Dipendra Parajuli: Formal analysis; Investigation; Methodology; Project administration; Validation; Writing – original draft; Writing – review & editing.

Acknowledgements

None.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Competing interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Guarantor of the article

Dipendra Parajuli is the guarantor of this article.

ORCID iDs

Amal Shine https://orcid.org/0000-0001-5251-3906

Nanlong Liu https://orcid.org/0000-0002-2081-2175

Sudaraka Tholkage https://orcid.org/0000-0001-9644-0358

Dipendra Parajuli https://orcid.org/0000-0001-5241-5943

Supplemental material

Supplemental material for this article is available online.

References

1. Siegel RL, Miller KD, Fuchs HE, *et al.* Cancer statistics, 2021. *CA: Can J Clin* 2021; 71: 7–33.
2. Sandouk F, Al Jerf F and Al-Halabi MH. Precancerous lesions in colorectal cancer. *Gastroenterol Res Pract* 2013; 2013: 457901.
3. Brenner H and Chen C. The colorectal cancer epidemic: challenges and opportunities for primary, secondary and tertiary prevention. *Br J Cancer* 2018; 119: 785–792.
4. Brenner H, Stock C and Hoffmeister M. Effect of screening sigmoidoscopy and screening colonoscopy on colorectal cancer incidence and mortality: systematic review and meta-analysis of randomised controlled trials and observational studies. *BMJ* 2014; 348: g2467.
5. Rex DK, Schoenfeld PS, Cohen J, *et al.* Quality indicators for colonoscopy. *Am J Gastroenterol* 2015; 110: 72–90.
6. Ma MX and Bourke MJ. Sessile serrated adenomas: how to detect, characterize and resect. *Gut Liver* 2017; 11: 747–760.
7. Rex DK. Serrated polyps in the colon. *Gastroenterol Hepatol* 2014; 10: 671–674.
8. Nishizawa T, Yoshida S, Toyoshima A, *et al.* Endoscopic diagnosis for colorectal sessile serrated lesions. *World J Gastroenterol* 2021; 27: 1321–1329.
9. Anderson JC, Butterly LF, Weiss JE, *et al.* Providing data for serrated polyp detection rate benchmarks: an analysis of the New Hampshire Colonoscopy Registry. *Gastrointest Endosc* 2017; 85: 1188–1194.
10. von Elm E, Altman DG, Egger M, *et al.* The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *PLoS Med* 2007; 4: e296.
11. Anderson JC and Butterly LF. Colonoscopy: quality indicators. *Clin Transl Gastroenterol* 2015; 6: e77.
12. El-Halabi MM, Barrett PR, Martinez Mateo M, *et al.* Should we measure adenoma detection rate for gastroenterology fellows in training? *Gastroenterology Res* 2018; 11: 290–294.
13. Facciorusso A, Buccino VR, Tonti P, *et al.* Impact of fellow participation on colon adenoma detection rates: a multicenter randomized trial. *Gastrointest Endosc* 2020; 92: 1228–1235.
14. Rogart JN, Siddiqui UD, Jamidar PA, *et al.* Fellow involvement may increase adenoma detection rates during colonoscopy. *Am J Gastroenterol* 2008; 103: 2841–2846.
15. Lee J, Park SW, Kim YS, *et al.* Risk factors of missed colorectal lesions after colonoscopy. *Medicine* 2017; 96: e7468.
16. O'Connell BM and Crockett SD. The clinical impact of serrated colorectal polyps. *Clin Epidemiol* 2017; 9: 113–125.
17. Szylberg Ł, Janiczek M, Popiel A, *et al.* Serrated polyps and their alternative pathway to the colorectal cancer: a systematic review. *Gastroenterol Res Pract* 2015; 2015: 573814.
18. Fan C, Younis A, Bookhout CE, *et al.* Management of serrated polyps of the colon. *Curr Treat Options Gastroenterol* 2018; 16: 182–202.
19. Atkinson NSS, Ket S, Bassett P, *et al.* Narrow-band imaging for detection of neoplasia at colonoscopy: a meta-analysis of data from individual patients in randomized controlled trials. *Gastroenterology* 2019; 157: 462–471.
20. Pohl J, Schneider A, Vogell H, *et al.* Pancolonic chromoendoscopy with indigo carmine versus standard colonoscopy for detection of neoplastic lesions: a randomised two-centre trial. *Gut* 2011; 60: 485–490.
21. Zhou G, Xiao X, Tu M, *et al.* Computer aided detection for laterally spreading tumors and sessile serrated adenomas during colonoscopy. *PLoS One* 2020; 15: e0231880.
22. Haque TR, Bradshaw PT and Crockett SD. Risk factors for serrated polyps of the colorectum. *Dig Dis Sci* 2014; 59: 2874–2889.
23. Russo P, Barbeiro S, Awadie H, *et al.* Management of colorectal laterally spreading tumors: a systematic review and meta-analysis. *Endosc Int Open* 2019; 7: E239–E259.
24. Togashi K, Utano K, Kijima S, *et al.* Laterally spreading tumors: limitations of computed tomography colonography. *World J Gastroenterol* 2014; 20: 17552–17557.
25. Mohan BP, Facciorusso A, Khan SR, *et al.* Real-time computer aided colonoscopy versus standard colonoscopy for improving adenoma detection rate: a meta-analysis of randomized-controlled trials. *EClin Med* 2020; 29–30: 100622.
26. Hassan C, Bhandari P, Antonelli G, *et al.* Artificial intelligence for non-polypoid colorectal neoplasms. *Dig Endosc* 2021; 33: 285–289.
27. Li T, Glissen Brown JR, Tsourides K, *et al.* Training a computer-aided polyp detection system to detect sessile serrated adenomas using public domain colonoscopy videos. *Endosc Int Open* 2020; 8: E1448–E1454.