ORIGINAL ARTICLE

AG-2021-63
doi.org/10.1590/S0004-2803.202100000-64

Teaching basic colonoscopy skills: quality and safety standards can be fulfilled in an outpatient university center

Marley Ribeiro **FEITOSA**, Rogério Serafim **PARRA**, Lucas Fernandes de **FREITAS**, Hugo Parra de **CAMARGO**, José Joaquim Ribeiro da **ROCHA** and Omar **FÉRES**

Received: 18 March 2021
Accepted: 23 March 2021

ABSTRACT – **Background** – Recent studies have shown that endoscopy fellows can perform colonoscopy effectively and safely. However, little is known about the performance of surgical residents without prior knowledge of endoscopic techniques. **Objective** – To assess whether quality indicators were met at an outpatient endoscopy center and whether surgical residents, without prior upper or lower endoscopy skills, could perform colonoscopy adequately. **Methods** – A prospective non-randomized cohort study was undertaken. All exams were performed either by assistant physicians or by residents. Quality measures were compared between those groups. **Results** – A total of 2720 colonoscopies were analyzed. In the resident group, we observed older patients (57.7±12.7 years vs 51.5±14.5 years, $P<0.001$), a higher prevalence of screening colonoscopies (52% vs 39.4%, $P<0.001$) and a higher prevalence of colorectal cancer (6.4% vs 1.8%, $P<0.001$). The cecal intubation rate was higher in the attending group (99.9% vs 89.3%; $P<0.001$). The polyp detection rate was 40.8%, and no differences were observed between the studied groups. The residents had a higher rate of perforation in all exams (0.4% vs 0%; $P=0.02$). Postpolypectomy bleeding and 7-day readmission rates were the same (0.2%). All readmissions in 7 days occurred due to low digestive bleeding, and none required intervention. **Conclusion** – Quality indicators were met at a university outpatient endoscopy center; however, medical residents achieved lower rates of cecal intubation and higher rates of perforation than the attending physicians.

Keywords – Colonoscopy; resident education; quality metrics.

INTRODUCTION

Adhering to a screening program can be considered one of the greatest tools against colorectal cancer (CRC)[1,2]. Many screening programs have been developed, and different modalities of exams are available[3]. However, the adoption of colonoscopy as the preferred method in countries such as the United States of America and Japan has been epidemiologically linked with CRC burden reduction[4]. This may be explained by the fact that the exam allows the detection and removal of premalignant lesions[5]. Additionally, a diagnosis of CRC can be made earlier in asymptomatic patients[6].

In Brazil, there has been an increasing impact of CRC, which can be explained by the aging population, a greater exposure to risk factors and a lack of adequate screening[4,7]. In fact, access to colonoscopy is difficult for most Brazilians that depend on public health. To offer the exam comprehensively, financial investments are necessary to build adequate infrastructure and train health teams. In the state of São Paulo, the largest state of Brazil, 14670 new cases of CRC are expected this year[8]. To meet these and other demands for specialized care and tests, medium complexity health centers, known as specialty outpatient clinics and state hospitals, have been created[9].

Since 2010, ambulatory procedures of medium complexity and without the need for prolonged hospitalization have been transferred to university centers of medium complexity, and colonoscopies for low-risk patients has been performed on an outpatient basis in the same units. A colonoscopy teaching structure was created, and surgical residents, with no previous colonoscopy experience, can perform the initial training.

To ensure the quality of endoscopic examination, it is important to adopt indicators associated with increased accuracy and reduced complications[10,11]. Recent studies have shown that endoscopy fellows can perform the exam effectively and safely[12]. However, little is known about the performance of surgical residents without prior knowledge of endoscopic techniques. Additionally, in some studies, the participation of trainees and attending physicians is too intertwined to define who truly performed the exam[13]. Therefore, the aim of the present study is to assess whether quality indicators were met at an outpatient endoscopy center and whether surgical residents, without prior upper or lower endoscopy skills, could perform the exam adequately.

METHODS

Study design, setting and data collection

We conducted a prospective non-randomized cohort study and gathered information to build a colonoscopy database at Ribeirão Preto Medical School, University of São Paulo. The following vari-

Declared conflict of interest of all authors: none
Disclosure of funding: none
Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo, Departamento de Cirurgia e Anatomia, Ribeirão Preto, SP, Brasil.
Corresponding author: Marley Ribeiro Feitosa. E-mail: mrfeitosa@hcrp.usp.br

ables were collected continuously and prospectively: patient name, registration number, age, gender, colonoscopy indication, resident participation, attending participation, type of anesthesia, bowel preparation quality, cecal intubation, endoscopic findings, macroscopic characteristics and locations of removed polyps, clinical and surgical complications related to the procedure, readmission rates (7-day/30-day) and mortality rate (30-day). All adult patients (>18 years of age) who underwent colonoscopy from January 1, 2010 to December 31, 2015 were selected. Flexible sigmoidoscopies and colonoscopies in which cecal intubation was not intended were excluded, as most quality indicators would not be able to be calculated. Patients with previous colorectal resection were also excluded from the analysis. During the selected period, four attending physicians and 18 coloproctology residents performed the exams. All residents were in the first year of the coloproctology residency program and had no previous endoscopy experience.

Bowel preparation was classified according to the modified Aronchick scale and was considered adequate when the entire mucosa could be seen even when residual staining and small fragments of stool were observed[14]. Colonoscopy indication was classified as appropriate or inappropriate, and a complete list of appropriate indications has been published by the American Society for Gastrointestinal Endoscopy (ASGE)[15]. To identify the location of colorectal lesions, the colon was divided into the cecum, ascending colon, transverse colon, descending colon, sigmoid colon and rectum. Colonoscopies were divided into two groups according to the endoscopist: (a) resident, in which colonoscopy insertion and withdrawal was performed exclusively by a coloproctology resident; and (b) attending, in which an attending physician performed complete insertion and/or withdrawal of the colonoscopy tube or when there were no coloproctology residents in the sector.

Procedure and colonoscopy training program

All patients were referred by primary care physicians. At the outpatient center, they were evaluated by the attending endoscopist, anesthesiologist, and nursing team on the same day. All colonoscopies were scheduled 15-30 days after the initial clinical assessment. Only non-obese patients without uncompensated comorbidities were admitted for colonoscopy at the institute. To prepare the colon, 1 L of 10% mannitol was given orally. Sedations with propofol and fentanyl were carried out by the anesthesiologists. All exams were performed on Olympus tubes and image processors (CF-Q150L/CV-150, Olympus Corporation®) and recorded in video format for analysis. Procedures were carried out in the same endoscopy room during the course of the day. Attending endoscopists staffed and monitored all procedures. When there were no residents, the attending endoscopist himself performed the exams. A basic colonoscopy training protocol was carried out as follows: in the first month of training, the residents were given theoretical instructions on basic colonoscopy techniques and were only allowed to withdraw the colonoscopy tubes under direct supervision of the attending physicians, who had performed tube insertion. In the second month, the residents had reached sufficient competency to insert the colonoscopy tube with the help of the attending physician (four-handed intubation technique) and to withdraw the tube with no help. From the third month until the end of the program, the residents performed the exams without direct assistance, and the attending physicians only performed interventions to rectify the colonoscopy tube and pass a difficult segment. Once that segment was traversed, the resident resumed the exam. Basic training lasted for one year and included diagnostic colonoscopies, endoscopic tattooing and polypectomy (cold forceps, cold snare and hot snare). All colonoscopies included in the final analysis were performed by residents, after three months of training.

Comparison between residents and attending physicians

An evaluation was carried out to identify whether the characteristics of the patients were comparable in terms of gender, age, colonoscopy indication, presence of colorectal malignancy and presence of diverticular disease of the colon (DDC). For the analysis of performance and safety, we used the endoscopic quality indicators of the ASGE[10] and the European Society of Gastrointestinal Endoscopy (ESGE)[11], illustrated in TABLE 1. The adenoma detection rate (ADR) was not calculated since, in most patients, pathological studies were performed at external centers. The ADR was replaced by the polyp detection rate (PDR), according to the recommendations of the ESGE. We also compared all quality indicators between residents and attending physicians.

TABLE 1. Quality indicators used in the present study.

Measure	Society	Description	Target
Appropriate Indications*	ASGE	Frequency in which indication is appropriate	>80.0%
Adequate Bowel prep	ESGE	Percentage of adequately prepared bowel	≥95.0%
Cecal intubation (All colonoscopies)	ASGE	Percentage of colonoscopies where cecum is completely inspected	≥90.0%
Cecal intubation (Screening colonoscopies)	ESGE	Percentage of screening colonoscopies where cecum is completely inspected	≥95.0%
Polyp detection rate (Patients ≥50 years)	ESGE	Percentage of colonoscopies in which at least one polyp was identified	≥40.0%
Perforation (All colonoscopies)	ASGE	Incidence of perforation in all exams	<0.2%
Perforation (Screening colonoscopies)	ASGE	Incidence of perforation in screening colonoscopies	<0.1%
Postpolypectomy bleeding	ASGE	Incidence of postpolypectomy bleeding	<1.0%
7-day readmission rate	ESGE	% of patients with endoscopic-related complications readmitted in 07 days	≤0.5%
30-day readmission rate	ESGE	% of patients with endoscopic-related complications readmitted in 30 days	≤0.5%
30-day mortality rate	ESGE	% of patients endoscopic related deaths	≤0.5%

*A complete list of appropriate indications has been published[15]. ASGE: American Society for Gastrointestinal Endoscopy; ESGE: European Society of Gastrointestinal Endoscopy.

Ethics approval

This study was approved by the Institutional Review Board and the Ethics Committee (n. 89072418.9.0000.5440). All patients signed informed consent forms, allowing the colonoscopy and data collection. All procedures were in accordance with the ethical standards of the institutional and national committees on human experimentation and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Statistical analysis

Categorical variables are expressed as absolute and relative frequencies. Continuous variables are expressed as the means ± standard deviations (SDs). The Kruskal-Wallis test was used to check for normality in the distributions of the variables. Comparisons of categorical and continuous variables between groups were performed using Fisher's exact test or ANOVA. A *P*-value <0.05 was considered statistically significant. SPSS version 20.0 software (SPSS, Chicago, IL, USA) was used for statistical analysis.

RESULTS

A total of 2720 colonoscopies were analyzed. Most of the exams were performed by assistant physicians (n=1626, 59.7%). Most patients were female (n=1717, 63.1%), and the mean age was 54.1±14.2 years. The main indication for colonoscopy was CRC screening (n=1210, 44.5%). Polyps and adenocarcinomas were diagnosed in 971 (35.7%) and 100 (3.7%) patients, respectively. DDC was observed in 908 (33.4%) patients. Baseline characteristics varied between the two groups. In the resident group, we observed older patients (57.7±12.7 years vs 51.5±14.5 years, *P*<0.001), a higher prevalence of screening colonoscopies (52% vs 39.4%, *P*<0.001) and a higher prevalence of CRC (6.4% vs 1.8%, *P*<0.001) and DDC (36.5% vs 31.3%, *P*<0.005). The baseline characteristics of the patients and colonoscopies are illustrated in TABLE 2.

In total, 1499 colorectal polyps were removed from 971 patients, and 100 adenocarcinomas were diagnosed. The rectum and sigmoid colon were the most affected segments, with a total of 672 (45%) polyps and 68 (68%) adenocarcinomas diagnosed (FIGURE 1). DDC was observed in 908 (33.4%) patients and most frequently distributed in the left (438, 48.2%) and right colons (403, 44.4%). In 67 (7.4%) patients, DDC affected all segments of the colon.

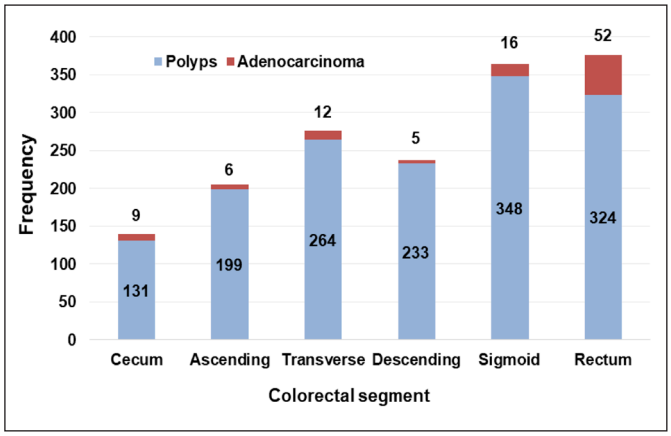

FIGURE 1. Distribution of polyps and adenocarcinomas according to colorectal segments.

Indications for colonoscopy were appropriate in 2331 (85.7%) patients, and bowel preparation was considered adequate in 2667 (98.1%) exams. Higher rates of adequate bowel preparation were observed in the attending group (99.2% vs 96.3%; *P*<0.001). The cecum was completely observed in 2602 (95.7%) of all exams and in 1155 (95.5%) screening colonoscopies. The cecal intubation rate in all exams was higher in the attending group (99.9% vs 89.3%; *P*<0.001). Reasons for incomplete colonoscopies were

TABLE 2. Baseline characteristics of patients and colonoscopies according to examiner status.

Characteristic	All patients	Residents	Attending	*P*-value*
Age in years (Mean±SD)	54.0±14.1	57.7±12.7	51.5±14.5	<0.001
Gender				
Male	1003 (36.9%)	404 (36.9%)	599 (36.8%)	0.96
Female	1717 (63.1%)	690 (63.1%)	1027 (63.2%)	
Indication				
CRC screening	1210 (44.5%)	569 (52%)	641 (39.4%)	<0.001
GI bleeding	695 (25.6%)	248 (22.7%)	447 (27.5%)	0.005
Abdominal pain	324 (11.9%)	124 (11.3%)	200 (12.3%)	0.46
Diarrhea	176 (6.5%)	1 (2.8%)	145 (8.9%)	<0.001
Bowel habit change	119 (4.4%)	36 (3.3%)	83 (5.1%)	0.02
Anemia	92 (3.4%)	36 (3.3%)	56 (3.4%)	0.91
Constipation	65 (2.4%)	32 (2.9%)	33 (2.0%)	0.16
Tenesmus	31 (1.1%)	15 (1.4%)	16 (1.0%)	0.36
Weight loss	8 (0.2%)	3 (0.3%)	5 (0.3%)	1.00
Polyps prevalence	971 (35.7%)	393 (35.9%)	578 (35.5%)	0.87
CRC prevalence	100 (3.7%)	70 (6.4%)	30 (1.8%)	<0.001
DDC prevalence	908 (33.4%)	399 (36.5%)	509 (31.3%)	0.005

SD: standard deviation; CRC: colorectal cancer; GI: gastrointestinal; DDC: diverticular disease of the colon. *P-value calculated by ANOVA or Fisher's exact test.

angulation of the bowel loops (58; 49.2%), bowel obstruction (23; 19.5%), inadequate bowel preparation (19; 16.1%), adhesions (8; 6.8%), fixation of the bowel loops (4; 3.4%), bowel perforation (3; 2.5%), cardiac instability (2; 1.7%) and respiratory complications (1; 0.8%). In 1413 (51.9%) exams, the ileum was intended to be intubated, and in those cases, the ileal intubation rate was higher in the attending group (69.5% vs 62.0%; *P*=0.004). The PDR was 40.8%, and no differences were observed between the groups. The residents had a higher rate of perforation in all exams (0.4% vs 0%; *P*=0.02). Postpolypectomy bleeding and 7-day readmission rates were the same (0.2%). All readmissions in 7 days occurred due to low digestive bleeding, and none required intervention. We did not observe 30-day readmissions or deaths related to colonoscopy. TABLE 3 summarizes all quality indicators.

DISCUSSION

The findings of this study demonstrate that outpatient colonoscopy can be performed in a university center while maintaining quality indicators. To the best of our knowledge, this is the first study to address colonoscopy quality indicators in a Brazilian outpatient endoscopy center where coloproctology residents, with no previous endoscopic skills, performed their colonoscopy training program. There is great interest in outpatient procedures such as colonoscopy in both public and private settings[16]. In the state of São Paulo, less complex procedures with no need for hospitalization have been transferred to specialized outpatient facilities of medium complexity[9]. In our city, a substantial number of low-risk patients managed to be removed from the colonoscopy queues of highly complex public hospitals, which remained responsible for high-risk cases or those in need of hospitalization. Another positive effect of this phenomenon was the identification of less complex patients, in which colonoscopy training presented fewer challenges, since the exam could be performed in more favorable cases. However, information on quality was missing in our country. We used a combination of American and European quality indicators to define appropriate targets for performance. We believe that these practical recommendations can be adapted to our country, given the behavioral similarity of our populations. Furthermore, in our country, there is no strong scientific evidence to create a similar instrument without using the same references.

Regarding the differences observed in the mean age of patients and in the indications for colonoscopies between the endoscopist groups, we believe that their clinical impact on performance is irrelevant. Among the most common risk factors for difficult or incomplete colonoscopy, inadequate sedation, young age, female gender, high body mass index and anatomical changes of the sigmoid colon stand out[17-19]. However, the higher prevalence of CRC and DDC in the resident group may have interfered with performance. Although CRC is not a classic predictor of incomplete colonoscopy, advanced disease can cause obstruction of the colonic lumen. In the case of DDC, spastic forms that lead to tortuosity can be a predictor of a difficult/incomplete examination[19]. In our study, obstruction was a relevant finding in patients with incomplete examinations.

In relation to quality indicators, the target number of appropriate indications was reached in both groups. This is because our service has organized protocols for requesting exams, which were sent to the requesting physicians. This effort is important in a setting with limited health resources, as observed in our country[20]. Proper indications increase the diagnostic yield of colonoscopy and decrease the risks of unnecessary procedures[11,21]. In our study, chronic constipation and isolated abdominal pain were considered inadequate indications since they were nonspecific and allowed little clinical information to be added[22,23]. On the other hand, colonoscopies performed for intestinal bleeding, especially in the presence of other warning signs such as changes in bowel habits, tenesmus, anemia and weight loss, can increase the likelihood of diagnosing neoplastic lesions[24,25].

The quality of the bowel preparation is also an important indicator. Complete colon cleansing is directly associated with better visualization of the entire mucosa from the rectum to the cecum and allows higher ADRs and PDRs[26]. Regarding bowel prep, a slight advantage was observed in the attending group, with higher rates of adequate colonic preparation, which may have contributed to their higher cecal intubation rate. However, in both groups, the adequate bowel preparation rates were considered satisfactory. Regarding cecal intubation, in all exams, the rates were satisfactory, with better scores for the attending physicians. However, the residents' low performance cannot be attributed only to skill differences, since the attending physicians were allowed to assist with the procedure when necessary. The difference may be explained by the patients' characteristics, since obstructive CRC and diverticular disease were more prevalent in the resident group.

TABLE 3. Quality indicators in all colonoscopies and comparison between residents and attending physicians.

Measure	Target	All exams	Residents	Attending	*P*-value*
Appropriate indications	>80.0%	2331 (85.7%)	938 (85.7%)	1393 (85.75)	1.000
Adequate bowel prep	≥95.0%	2667 (98.1%)	1054 (96.3%)	1613 (99.2%)	<0.001
Cecal intubation (all colonoscopies)	≥90.0%	2602 (95.7%)	977 (89.3%)	1625 (99.9%)	<0.001
Cecal intubation (screening colonoscopies)	≥95.0%	1155 (95.5%)	531 (96.7%)	624 (94.4%)	0.07
Polyp detection rate (patients ≥50 years)	≥40.0%	725 (40.8%)	316 (40.1%)	409 (41.4%)	0.62
Perforation (all colonoscopies)	<0.2%	4 (0.1%)	4 (0.4%)	0	0.02
Perforation (screening colonoscopies)	<0.1%	1 (0.1%)	1 (0.2%)	0	0.45
Postpolypectomy bleeding	<1.0%	2 (0.2%)	0	2 (0.4%)	0.50
7-day readmission rate	≤0.5%	5 (0.2%)	3 (0.3%)	2 (0.1%)	0.39
30-day readmission rate	≤0.5%	0	0	0	NC**
30-day mortality rate	≤0.5%	0	0	0	NC**

**P*-value calculated by Fisher's exact test. ***P*-value not computed due to a constant zero rate.

The ADR is perhaps the most important performance indicator for colonoscopy. It could not be calculated in this study since histopathological examinations of the polyps were performed in external institutes and we did not have access to all the reports. Instead, we used the PDR as the indicator, as recommended by ESGE, which can be equivalent to the ADR but with different relevance[11,27,28]. The advantage of measuring the PDR is that there is no dependence on secondary data (histopathological analysis); however, it can lead to unnecessary biopsy behavior in an attempt to circumvent the system. In the period the exams were performed, the PDR was not used as a quality indicator, and we believe that this bias did not exist.

For complications, the perforation rates of the residents were above the target. This can be expected by the lower level of skill; however, whenever necessary, the attending physicians intervened in the residents' exams to undo loops formed by the colonoscope or to traverse difficult segments. Other measures included gentle handling of the device, inflating as little as possible, handling controls with one finger at a time, and avoiding scope progression against any resistance and changes in patients' positions[29]. Even so, we believe that as the number of exams increases, these complications will decrease for the residents, since the overall perforation rates among the screening colonoscopies were acceptable. Other indicators, such as postpolypectomy bleeding and 7-day readmission, reached satisfactory levels, and no readmissions or deaths were observed 30 days after the colonoscopy. In a study with a higher number of patients, Chan et al. demonstrated that complications such as perforations and postpolypectomy bleeding were infrequent events, even in exams performed by trainees[30].

The present study shows interesting results in a relatively unknown group of endoscopists: coloproctology residents with no previous endoscopic training. Specialty outpatient clinics have reduced the wait for consultations and specialized exams and have proven to be an appropriate setting for colonoscopy training. However, some factors limit our conclusions. Since this is a non-randomized analysis, the study is subject to selection bias. However, even with a higher prevalence of diseases that can be limiting factors to completing the colonoscopy, such as advanced CRC and DDC of the colon, the residents generally performed well. Another limitation was the fact that in some residents' examinations, the attending physicians performed assistance maneuvers to reduce loops. This may have improved the residents' cecal intubation rates; however, it was a necessary safety measure, as they were examiners at the beginning of their training program without endoscopic experience. Despite the limitations, the information is important and leads us to conclude that the outpatient facility was adequate for training.

CONCLUSION

Performance indicators were achieved in an outpatient teaching center, and in general, complication rates reached recommended levels. The overall performance of the residents was satisfactory; however, they achieved lower rates of cecal intubation and higher rates of perforation than the attending physicians. These findings reinforce the need for constant monitoring in the context of teaching.

Authors' contribution

Feitosa MR: conceptualization, data curation, formal analysis, investigation, methodology, project administration, writing-original draft. Parra RS: writing-review and critical revision of manuscript. Freitas LF: data curation, formal analysis. Camargo HP: data curation, formal analysis. Rocha JJR: supervision and critical revision of manuscript. Féres O: project administration, supervision and critical revision of manuscript.

Orcid

Marley Ribeiro Feitosa: 0000-0002-4440-2023.
Rogério Serafim Parra: 0000-0002-5566-9284.
Lucas Fernandes de Freitas: 0000-0002-0746-7549.
Hugo Parra de Camargo: 0000-0001-7267-1880.
José Joaquim Ribeiro da Rocha: 0000-0001-7118-0545.
Omar Féres: 0000-0003-3593-0526.

Feitosa MR, Parra RS, Freitas LF, Camargo HP, Rocha JJR, Féres O. Ensino das habilidades básicas de colonoscopia: os padrões de qualidade e segurança podem ser atendidos em um centro universitário. Arq Gastroenterol. 2021;58(3):384-9.

RESUMO – **Contexto** – Estudos recentes mostraram que médicos em treinamento podem realizar a colonoscopia de maneira eficaz e segura. No entanto, pouco se sabe sobre a performance dos médicos residentes de cirurgia sem o conhecimento prévio das técnicas endoscópicas. **Objetivo** – Avaliar se os indicadores de qualidade foram atendidos em um centro de endoscopia ambulatorial e se os residentes de cirurgia, sem habilidades anteriores em endoscopia alta ou baixa, realizaram a colonoscopia de forma adequada. **Métodos** – Foi realizado um estudo de coorte prospectivo não randomizado. Todos os exames foram realizados por médicos assistentes ou residentes. Os indicadores de qualidade foram comparados entre esses grupos. **Resultados** – Um total de 2.720 colonoscopias foram analisadas. No grupo de médicos residentes, observamos pacientes mais velhos (57,7±12,7 anos vs 51,5±14,5 anos, *P*<0,001), maior prevalência de colonoscopias de rastreamento (52% vs 39,4%, *P*<0,001) e maior prevalência de câncer colorretal (6,4% vs 1,8%, *P*<0,001). A taxa de intubação cecal foi maior no grupo de médicos assistentes (99,9% vs 89,3%; *P*<0,001). A taxa de detecção de pólipos foi de 40,8% e não foram observadas diferenças entre os grupos estudados. Os médicos residentes tiveram maior índice de perfuração (0,4% vs 0%; *P*=0,02). O sangramento pós-polipectomia e as taxas de readmissão em 7 dias foram iguais (0,2%). Todas as readmissões em 7 dias ocorreram devido a hemorragia digestiva baixa e nenhuma intervenção foi necessária. **Conclusão** – Os indicadores de qualidade foram alcançados em um centro de endoscopia universitário; no entanto, os médicos residentes alcançaram taxas mais baixas de intubação cecal e taxas mais altas de perfuração do que os médicos assistentes.

Palavras-chave – Colonoscopia; educação de residentes; métricas de qualidade.

REFERENCES

1. Ladabaum U, Dominitz JA, Kahi C, Schoen RE. Strategies for Colorectal Cancer Screening. Gastroenterology. 2020;158:418-32. DOI: 10.1053/j.gastro.2019.06.043.
2. Levin TR, Corley DA, Jensen CD, Schottinger JE, Quinn VP, Zauber AG, et al. Effects of Organized Colorectal Cancer Screening on Cancer Incidence and Mortality in a Large Community-Based Population. Gastroenterology. 2018;155: 1383-1391.e5. DOI: 10.1053/j.gastro.2018.07.017.
3. Issa IA, Noureddine M. Colorectal Cancer Screening: An Updated Review of the Available Options. World J Gastroeterol. 2017;23:5086-96. DOI: 10.3748/wjg.v23.i28.5086.
4. Arnold M, Sierra MS, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global Patterns and Trends in Colorectal Cancer Incidence and Mortality. Gut. 2017;66:683-91. DOI: 10.1136/gutjnl-2015-310912.
5. Lin JS, Piper MA, Perdue LA, Rutter CM, Webber EM, O'Connor E, et al. Screening for Colorectal Cancer: Updated Evidence Report and Systematic Review for the US Preventive Services Task Force. JAMA. 2016 21;315:2576-94. DOI: 10.1001/jama.2016.3332.
6. Komuta K, Furui J, Haraguchi M, Kanematsu T. The Detection of Colorectal Cancer at an Asymptomatic Stage by Screening Is Useful. Hepatogastroenterology. 2000;47:1011-4. PMID: 11020866.
7. Souza DL, Jerez-Roig J, Cabral FJ, de Lima JR, Rutalira MK, Costa JA. Colorectal Cancer Mortality in Brazil: Predictions Until the Year 2025 and Cancer Control Implications. Dis Colon Rectum. 2014;57:1082-9. DOI: 10.1097/DCR.0000000000000186.
8. INCA. Estimativa 2020: incidência de câncer no Brasil / Instituto Nacional de Câncer José Alencar Gomes da SIlva. Rio de Janeiro: Fox Print 2019. p. 120.
9. Tadei VC, Braile DM. Specialty Outpatient Clinics: agility and resolution. Rev Bras Cir Cardiovasc. 2008;23:570-1. DOI: 10.1590/s0102-76382008000400019.
10. Rex DK, Schoenfeld PS, Cohen J, Pike IM, Adler DG, Fennerty MB, et al. Quality Indicators for Colonoscopy. Gastrointest Endosc. 2015;81:31-53. DOI: 10.1016/j.gie.2014.07.058.
11. Kaminski MF, Thomas-Gibson S, Bugajski M, Bretthauer M, Rees CJ, Dekker E, et al. Performance Measures for Lower Gastrointestinal Endoscopy: A European Society of Gastrointestinal Endoscopy (ESGE) Quality Improvement Initiative. United European Gastroenterol J. 2017;5:309-34. DOI: 10.1177/2050640617700014.
12. Klare P, Ascher S, Wagenpfeil S, Rapp D, Bajbouj M, Neu B, et al. Trainee Colonoscopists Fulfil Quality Standards for the Detection of Adenomatous Polyps. BMC Med. 2015;27;15:26. DOI: 10.1186/s12909-015-0312-7.
13. Qayed E, Shea L, Goebel S, Bostick RM. Association of Trainee Participation With Adenoma and Polyp Detection Rates. World J Gastrointest Endosc. 2017 16;9:204-10. DOI: 10.4253/wjge.v9.i5.204.
14. Kastenberg D, Bertiger G, Brogadir S. Bowel Preparation Quality Scales for Colonoscopy. World J Gastroenterol. 2018;24:2833-43. PMID: 30018478. DOI: 10.3748/wjg.v24.i26.2833.
15. Early DS, Ben-Menachem T, Decker GA, Evans JA, Fanelli RD, Fisher DA, et al. Appropriate Use of GI Endoscopy. Gastrointest Endosc. 2012;75:1127-31. DOI: 10.1016/j.gie.2012.01.011.
16. Frank M. Endoscopy in the Outpatient Setting. Clin Plastic Surg. 2013;40:419-27. DOI: 10.1016/j.cps.2013.04.006.
17. Lee ES, Kim BC, Hur BY, Kim MJ, Park HJ, Park SB, et al. Risk Factors Associated With Incomplete Colonoscopy Based on the Analysis of Computed Tomographic Colonography Findings. J Comput Assist Tomogr. 2018;42:675-9. DOI: 10.1097/RCT.0000000000000741.
18. Witte TN, Enns R. The Difficult Colonoscopy. Can J Gastroenterol. 2007;21:487-90. DOI: 10.1155/2007/520431.
19. Franco DL, Leighton JA, Gurudu SR. Approach to Incomplete Colonoscopy: New Techniques and Technologies. Gastroenterol Hepatol (N Y). 2017:476-83). PMID: 28867979.
20. Dos Santos AM, de Almeida PF. [Specialized Care in Health Regions: Challenges to Ensure Comprehensive Health Care in Brazil]. Rev Salud Publica (Bogota). 2018;20:301-07. DOI: 10.15446/rsap.V20n3.61392.
21. Kim SY, Kim HS, Park HJ. Adverse Events Related to Colonoscopy: Global Trends and Future Challenges. World J Gastroenterol. 2019;25:190-204. DOI: 10.3748/wjg.v25.i2.190.
22. Obusez EC, Lian L, Kariv R, Burke CA, Shen B. Diagnostic Yield of Colonoscopy for Constipation as the Sole Indication. Colorectal Dis. 2012;14:585-91. DOI: 10.1111/j.1463-1318.2011.02664.x.
23. Kueh SH, Zhou L, Walmsley RS. The Diagnostic Yield of Colonoscopy in Patients With Isolated Abdominal Pain. N Z Med J. 2013;126:36-44. PMID: 24154768.
24. Lasson A, Kilander A, Stotzer PO. Diagnostic Yield of Colonoscopy Based on Symptoms. Scand J Gastroenterol. 2008;43:356-62. DOI: 10.1080/00365520701679116.
25. Rasmussen S, Larsen PV, Søndergaard J, Elnegaard S, Svendsen RP, Jarbøl DE. Specific and Non-Specific Symptoms of Colorectal Cancer and Contact to General Practice. Fam Pract. 2015;32:387-94. DOI: 10.1093/fampra/cmv032.
26. Hassan C, East J, Radaelli F, Spada C, Benamouzig R, Bisschops R, et al. Bowel Preparation for Colonoscopy: European Society of Gastrointestinal Endoscopy (ESGE) Guideline - Update 2019. Endoscopy. 2019;51:775-94. DOI: 10.1055/a-0959-0505.
27. Niv Y. Polyp Detection Rate May Predict Adenoma Detection Rate: A Meta-Analysis. Eur J Gastroenterol Hepatol. 2018;30:247-51. DOI: 10.1097/MEG.0000000000001062.
28. Elhanafi S, Ortiz AM, Yarlagadda A, Tsai C, Eloliby M, Mallawaarachchi I, et al. Estimation of the Adenoma Detection Rate From the Polyp Detection Rate by Using a Conversion Factor in a Predominantly Hispanic Population. J Clin Gastroenterol. 2015;49:589-93. DOI: 10.1097/MCG.0000000000000179.
29. Rodrigues-Pinto E, Ferreira-Silva J, Macedo G, Rex DK. (Technically) Difficult Colonoscope Insertion - Tips and Tricks. Dig End. 2019;31:583-7. DOI: 10.1111/den.13465.
30. Chan DKH, Wong RKM, Yeoh KG, Tan KK. Accredited Residents Perform Colonoscopy to the Same High Standards as Consultants. Surg Endos. 2018;32:1377-81. DOI: 10.1007/s00464-017-5818-0.