

# Colonoscopic Perforation Incidence and Risk Factors in Rajavithi Training Hospital

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## Abstract

**Background:** The colonoscope has become a standard tool for diagnosing and treating pathological diseases of the colon. Colonoscopic perforation is one of the serious consequences associated with colonoscopy, and as a result, it may result in a high rate of morbidity and mortality.

**Objectives:** This study aims to determine the incidence and risk factors associated with colonoscopic perforation in a training institution.

**Methods:** A retrospective review of medical records was performed for patients undergoing colonoscopy in Rajavithi Hospital between 2009 and 2019, total 10,057 patient. The patient's demographic data, indication for colonoscopy, quality of bowel preparation, endoscopic procedure, perforation, and diagnostic were recorded.

**Results:** Between 2009 and 2019, 12,239 colonoscopy was performed and 2,182 colonoscopy was excluded. In total 0.71% (71/10,057) colonoscopic perforation was occurred. Multivariate logistic regression analysis reveals that previous gynecologic surgery (OR 41.1, *p*-value < 0.001, 95% CI 16.40-102.73), general anesthesia (OR 7.74, *p*-value 0.016, 95% CI 1.46-40.97), trainee (OR 20.74, *p*-value < 0.001, 95% CI 11.25-38.35) and polypectomy (OR 6.08, *p*-value < 0.001, 95% CI 3.15-11.70), EMR (OR 23.32, *p*-value < 0.001, 95% CI 6.02-90.41) and endoscopic subepithelial dissection (OR 89.99, *p*-value < 0.001, 95% CI 12.74-135.46) were significant.

**Conclusion:** Patients tend to have a higher colonoscopic perforation rate when they have a history of previous gynecological surgery or general anesthesia the colonoscopy to be performed by a trainee or polypectomy or endoscopic submucosal resection (EMR) or endoscopic submucosal dissection (ESD) to be performed. Even though we're aware of the risk factor, we must nevertheless handle each case with care and solely focus on high-risk populations in our practice.

**Keywords:** Colonoscopic perforation, Risk factors, Incidence, Training center, Colonoscope

## INTRODUCTION

Colonoscopy become a common procedure to diagnosis and treatment pathological conditions in the colon. Among the complication, perforation is serious so it may cause high morbidity and mortality. Aras et al reported morbidity and mortality rates in the large series were ranged between 21% to 53% and 0% to 26%, successively.<sup>1</sup> WSES guideline 2017<sup>2</sup> reported the

incidence is estimated to be 0.016-0.8% for diagnostic colonoscopies and 0.02-8% for therapeutic colonoscopies. WSES guideline 2017<sup>2</sup> and Cai et al<sup>3</sup> suggested three treatment methods: conservative, endoscopic, and surgical (laparoscopic and open surgery). The decision of management depended on the type of perforation, timing of detection, patient's condition, and the operator. Around 45 to 60 percent of colonoscopic perforation

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was identified during the colonoscopy, but a significant proportion of patients had a delayed diagnosis. In this case, (delayed detection) colonic perforations may lead to the development of secondary peritonitis and sepsis, which may need a more aggressive treatment and carry a higher morbidity including stoma rate<sup>3</sup> and mortality. Since the prevention and early detection is the key to management of perforation, the purpose of this study is to identify the factors that lead to colonoscopy perforation. This information may be used to design safety protocols for colonoscopies and post-operative monitoring in colonoscopy patients, particularly in high-risk populations.

This study's major objective is to identify a risk factor for colonoscopic perforation. Many studies of a similar kind have been conducted elsewhere, but only a handful in Thailand.

## MATERIALS AND METHODS

### Population cohort

Patients who had colonoscopy at Rajavithi Hospital between 2009 and 2019, total 10,057 patient. Generally, we advise discontinuing antiplatelet and anticoagulant medications before to elective colonoscopies. Our plan for bowel preparation consisted of a soft diet without vegetable and meat two days prior to colonoscopy and clear liquid diet with three liters of a polyethylene glycol (PEG)-based solution in the evening one day prior the colonoscopy and one liter in the morning of the day of the colonoscopy. Most of patient had colonoscopy in standard left lateral decubitus and forehead to knees. We recommend discontinuing antiplatelet and anticoagulant medications prior to elective colonoscopy. Colonoscopy was often performed under intravenous sedation with 25 to 50 milligrams of pethidine and 2.5 to 5 milligrams of midazolam, with the dose according on age and comorbidities. And in cases of general anesthesia, anesthesiologists adjusted medication dosages for each patient.

### Data collection

Data was extract from medical sheet records and electronic records. The patient characteristic, endoscopic information, surgical intervention and progression during admission were recorded. We enrolled the patients who had colonoscopy at Rajavithi Hospital between 2009 and

2019. Patient with unavailable data or missing data, and early case termination were excluded.

### Analysis

Patient was dividing into perforation group and non-perforation group. Data was analyzed with IBM SPSS version 22.0. Mean, SD, percent, Pearson's chi-squared, and Fisher's exact test were used for the univariate analysis. To evaluate the relationship between explanatory and outcome variables. In multivariate analysis, both the factor that had a statistically significant correlation with colonic perforation in univariate analysis and the factor that was considered to have a link were analyzed. with *p*-value of  $< 0.05$  considered to be significant.

## RESULTS

There were 10,057 patients proceeding to the final analysis. Overall patient mean age was  $58.60 \pm 10.79$  years, and 57 percent of patient was male. Incidence of colonoscopic perforation was 0.71 percent (71/10,057) (Table 1).

In univariate analysis factor that significant is history of previous surgery, anesthesia, endoscopist and indication of colonoscopy which all had *p*-value  $< 0.001$ . In our study age, gender and quality of bowel preparation were not significant.

History of previous gynecological surgery (*p*-value  $< 0.001$ , OR 41.05, 95% CI 16.404-102.734), general anesthesia (*p*-value 0.016, OR 7.74, 95% CI 1.46-40.97) and perform by trainee (*p*-value  $< 0.001$ , OR 20.74, 95% CI 11.25-38.25) (Table 2), procedure also contributed to the risk; endoscopic submucosal dissection (*p*-value  $< 0.001$ , OR 89.99, 95% CI 12.74-135.46), EMR (*p*-value  $< 0.001$ , OR 23.32, 95% CI 6.02-90.41), EMR (*p*-value  $< 0.001$ , OR 23.32, 95% CI 6.02-90.41) and polypectomy (*p*-value  $< 0.001$ , OR 6.08, 95% CI 3.15-11.70), (Table 3). In this research, patients who underwent argon plasma coagulation, dilatation, endoscopic ultrasound-guided fine-needle aspiration, and rubber band ligation did not have perforation.

Additionally, we found the perforation site at intra-peritoneum rectum 7 (10%), sigmoid 33 (46%), descending colon 6 (8%), transverse colon 5 (7%), ascending colon 4 (6%), cecum 11 (15%), and ileum 5 (7%), (Table 4).

**Table 1** Baseline patient characteristic

Characteristics	Perforation group 71 (%)	Non-perforation group 9,986 (%)	p-value
<b>Age (58.60 ± 10.79)</b>	58.59 ± 10.80	57.83 ± 11.55	0.1
<b>Sex</b>			0.39
Male	37 (0.6)	5,710 (99.4)	
Female	34 (0.8)	4,276 (99.2)	
<b>Previous surgery</b>			< 0.001*
Non	51 (0.6)	8,960 (99.4)	
Abdomen	0 (0.0)	752 (100)	
Gynecologic	18 (34)	35 (66)	
Colorectal	2 (0.9)	227 (99.1)	
Thoracic	0 (0.0)	12 (100)	
<b>Anesthesia</b>			< 0.001*
Sedate	60 (0.6)	9,981 (99.4)	
General anesthesia	11 (68.8)	5 (31.3)	
<b>Endoscopist</b>			< 0.001*
Staff	35 (0.4)	9,484 (99.6)	
Trainee	36 (6.7)	502 (93.3)	
<b>Quality of bowel preparation</b>			0.463
Clear	55 (0.7)	8,079 (99.3)	
Poor	16 (0.8)	1,907 (99.2)	
<b>Indication</b>			< 0.001*
Diagnostic	56 (0.6)	9,896 (99.4)	
Therapeutic	15 (14.3)	90 (85.7)	
<b>Endoscopic procedures</b>			< 0.001*
Non	15 (0.2)	7,150 (99.8)	
Polypectomy	37 (2.0)	1,850 (98.0)	
EMR	6 (8.3)	66 (91.7)	
ESD	13 (59.1)	9 (40.9)	
Biopsy	0 (0.0)	850 (100)	
APC	0 (0.0)	27 (100)	
Dilatation	0 (0.0)	24 (100)	
EUS & FNA	0 (0.0)	4 (100)	
RBL	0 (0.0)	6 (100)	

SD: Standard deviation; EMR: Endoscopic mucosal resection; ESD: Endoscopic submucosal resection; APC: Argon plasma coagulation; EUS & FNA: Endoscopic ultrasound and fine needle aspiration; RBL: Rubber band ligation

**Table 2** Multivariate logistic regression analysis between History of previous surgery and colonoscopic perforation

Characteristics	p-value	Odds ratio	95% CI	
			Lower	Upper
<b>History of previous surgery</b>	< 0.001			
Abdomen	0.99	0	0	-
Gynecologic	< 0.001	41.051	16.404	102.734
Colorectal	0.137	3.139	0.696	14.162
Thoracic	0.999	0	0	-
<b>General anesthesia</b>	0.016	7.74	1.462	40.966
<b>Perform by trainee</b>	< 0.001	20.739	11.245	38.247
<b>Therapeutic as Indication</b>	0.089	4.422	0.795	24.587

**Table 3** Multivariate logistic regression analysis between endoscopic procedure and colonoscopic perforation

Characteristics	p-value	Odds ratio	95% CI	
			Lower	Upper
<b>Endoscopic procedure</b>	< 0.001			
Polypectomy	< 0.001	6.076	3.155	11.701
EMR	< 0.001	23.321	6.016	90.405
ESD	< 0.001	89.994	12.745	635.456
Biopsy	0.99	0	0	-
APC	0.998	0	0	-
Dilatation	0.998	0	0	-
EUS & FNA	0.999	0	0	-
RBL	0.999	0	0	-

EMR: Endoscopic mucosal resection; ESD: Endoscopic submucosal resection; APC: Argon plasma coagulation; EUS & FNA: Endoscopic ultrasound guide fine-needle aspiration; RBL: Rubber band ligation

**Table 4** Perforation site

Perforation site	Indication	
	Diagnostic n (%)	Therapeutic n (%)
Intraperitoneal rectum	4 (7.1)	3 (20)
Sigmoid	32 (57.1)	1 (6.7)
Descending colon	6 (10.7)	0
Splenic flexure	0	1 (6.7)
Transverse colon	1 (1.8)	1 (6.7)
Hepatic flexure	0	2 (13.3)
Ascending colon	0	4 (26.7)
Ceacum	8 (14.3)	3 (20)
Ileum	5 (8.9)	0

## DISCUSSION

In general, colonoscopic perforation increases morbidity and mortality. As we mentioned earlier regarding management, in the minimally invasive era, with the advancement of technologies, endoscopic and laparoscopic management have become more prevalent and widely accepted. However, their use is typically limited to intra-colonoscopic and early detection cases, while open surgery remains an option for late detection and severe cases. It is obvious that preventing perforation is the best course of action, but since this was unattainable, one of the solutions to this disaster was to identify high-risk factors in order to establish a protocol that may help in the prevention or early diagnosis of the case.

In our study age and gender did not have a statistical difference in perforation and non- perforation group. Even though in our study we have more female in perforation group, but it was no statistically significant in perforation comparing to male, we may need more population to show a statistically significant result since the rate of perforation is relatively low on its own or gender was not a significant factor. Some studies also show an association between age, gender, and colonoscopic perforation, such as, Cha RR<sup>4</sup> found that female and older age trend to have higher perforation rate. Another report by Waye JD<sup>5</sup> was describe that women trend to have longer colon that pack in smaller abdominal cavity resulting in many twists and turns in colon, they mention about previous pelvic surgery and diverticular disease also increase perforation rate. Cooper GS<sup>6</sup> report that using of anesthesia service has higher risk of any complication and perforation rate (OR, 1.07; 95% CI 1.00-1.15). Anesthesia has a direct impact in colonoscopy outcomes may, in the absence of patient feedback, increased colonic-wall tension from colonoscopy pressure may not be identified by the endoscopist.<sup>7</sup> Usually, general anesthesia was done in group of difficult process or non-cooperative patient thus the complexity of procedure itself would be a cause of perforation. In this study, however, a multivariate analysis demonstrated that general anesthesia was an independent risk. One study in France<sup>8</sup> reported that the relationship between the endoscopist's age and the perforation rate tends to be U-shaped with a higher risk for younger and older physicians, after adjustment for the number of procedures performed each year. This result may be the result of a cautious intubation of novice and experienced operator tend to do more complex and challenging procedure. In addition, doing less than 300

colonoscopies annually was a risk factor for perforation, and high volume endoscopists may minimize perforation rates. Thus, high risk patient colonoscopy should be performed by experience endoscopist or Trainer.<sup>9</sup> Poor bowel preparation is known to be related with technical difficulties and may had consequently a greater complication risk, but in our research, we did not see a statistically significant difference between the two groups. In our study perforation rate were 0.71 percent (71/10,057), 0.56 percent (56/9,952), 14.28 percent (15/105) for overall, diagnostic and therapeutic colonoscopies respectively. In therapeutic group we have 10 polypectomy, 19 endoscopic mucosal resection, 21 endoscopic submucosal dissection, 25 argon plasma coagulation, 24 dilatation and 6 rubber band ligations. Study reported in 1998 by Ch. Wullstein et al.<sup>10</sup> reported the incidence of perforation is 0.1-0.8% for diagnostic colonoscopy and 0.15-3% for therapeutic colonoscopy, in 2016 systematic review of post-colonoscopy complication done by Ankie R. et al.<sup>11</sup> reported overall peroration rate was 0.05 percent (0.08 percent in therapeutic group, and 0.04 percent in diagnostic group). One of the largest data reported by Edmund Derbyshire et al.<sup>12</sup> reported 263,129 colonoscopies were analyzed, and the rate of perforation was 0.06 percent and 70.1 percent of perforations occurred during therapeutic colonoscopies, the same as our report that therapeutic colonoscopies have higher risk of perforation more than diagnostic colonoscopies. In our study the perforation were 1.96 percent (37/1,887), 8.3 percent (6/72) and 59% (13/22) for Polypectomy, endoscopic mucosal resection and ESD respectively. In our report the perforation rate quite higher that the reports that reported by Keisei T. et al.<sup>13</sup> reported perforation rate for 0.58 percent for endoscopic mucosal resection and 14 percent for and endoscopic submucosal dissection. In our series we had a successfully endoscopic management 6.7 percent (1/15), 2.9 percent (2/37), 16.7 percent (1/6) and 53.8 percent (7/13) in colonoscopy, polypectomy, endoscopic mucosal resection and endoscopic submucosal dissection respectively. Our study's mortality rate was 7% (5/71) and comparable to WSES<sup>2</sup> 5-25%. The perforation site reported by Iqbal CW. et al.<sup>14</sup> Were Sigmoid/rectosigmoid (52%), cecum (17%), ascending colon (14%), descending colon (8%), transverse colon (7%) and rectum (1%) and in our report, we found the perforation site at intraperitoneum rectum 7 (10%), sigmoid 33 (46%), descending colon 6 (8%), transverse colon 5 (7%), ascending colon

4 (6%), cecum 11 (15%), ileum 5 (7%), (Table 4). Sigmoid colon has the greatest risk of perforation. This is because diseases such as diverticulitis and gynecologic illness (with or without a history of pelvic surgery) may produce pelvic inflammation and adhesion, resulting in sigmoid angulation and tortuousness.

The limitation of this research was the lack of particular polypectomy technique and its specifics including other substantial factor such as case volume of trainee, bowel preparation scale and BMI of patient were not included in this study.

### CONCLUSION

Colonoscopic perforation has a great morbidity and mortality. We all do not want this to occur in our practice, thus it is essential to train under supervision of an experienced operator and practice carefully. Finally, patients tend to have a higher colonoscopic perforation rate when they have a history of previous gynecological surgery, general anesthesia, the colonoscopy to be performed by a trainee, polypectomy or endoscopic mucosal resection or endoscopic submucosal resection to be performed. In the high-risk category, we should be on the lookout for any warning signs and initiate an early evaluation for prompt treatment.

### REFERENCES

1. Aras A, Oran E, Seyit H, et al. Colonoscopic Perforations, What is Our Experience in a Training Hospital? *Surg Laparosc Endosc Percutan Tech.* 2016;26:44-8.
2. de'Angelis N, Di Saverio S, Chiara O, et al. 2017 WSES Guidelines for the Management of Iatrogenic Colonoscopy Perforation. *World J Emerg Surg.* 2018;13:5.
3. Cai SL, Chen T, Yao LQ, et al. Management of Iatrogenic Colorectal Perforation: From Surgery to Endoscopy. *World J Gastrointest Endosc.* 2015;7:819-23.
4. Cha RR, Kim HJ, Lee CM, et al. Clinical Characteristics and Outcome of Iatrogenic Colonic Perforation Related to Diagnostic vs. Therapeutic Colonoscopy. *Surg Endosc.* 2022;36:5938-46.
5. Waye JD. Difficult Colonoscopy. *Gastroenterol Hepatol (N Y).* 2013;9:676-8.
6. Cooper GS, Kou TD, Rex DK. Complications Following Colonoscopy with Anesthesia Assistance: A Population-Based Analysis. *JAMA Intern Med.* 2013;173:551-6.
7. Wernli KJ, Brenner AT, Rutter CM, et al. Risks Associated with Anesthesia Services During Colonoscopy. *Gastroenterology.* 2016;150:888-94.
8. Chukmaitov A, Bradley CJ, Dahman B, et al. Association of Polypectomy Techniques, Endoscopist Volume, and Facility Type with Colonoscopy Complications. *Gastrointest Endosc.* 2013;77:436-46.
9. Laanani M, Coste J, Blotière PO, et al. Patient, Procedure, and Endoscopist Risk Factors for Perforation, Bleeding, and Splenic Injury after Colonoscopies. *Clinical Gastroenterology and Hepatology.* 2019;17:719-727.e13.
10. Wullstein C, Köppen M, Gross E. Laparoscopic Treatment of Colonic Perforations Related to Colonoscopy. *Surg Endosc.* 1999;13:484-7.
11. Reumkens A, Rondagh EJ, Bakker CM, et al. Post-Colonoscopy Complications: A Systematic Review, Time Trends, and Meta-Analysis of Population-Based Studies. *Am J Gastroenterol.* 2016;111:1092-101.
12. Derbyshire E, Hungin P, Nickerson C, et al. Colonoscopic Perforations in the English National Health Service Bowel Cancer Screening Programme. *Endoscopy.* 2018;50:861-70.
13. Taku K, Sano Y, Fu KI, et al. Iatrogenic Perforation Associated with Therapeutic Colonoscopy: A Multicenter Study in Japan. *J Gastroenterol Hepatol.* 2007;22:1409-14.
14. Iqbal CW, Cullinane DC, Schiller HJ, et al. Surgical Management and Outcomes of 165 Colonoscopic Perforations from a Single Institution. *Arch Surg.* 2008;143:701-6.