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Delays in colonoscopy start time are associated with reductions in adenoma detection rates

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ABSTRACT

Background: Prior investigations of the impact of case delays on adenoma detection rates have not found a significant association, though these studies included modest delays, with few cases delayed by more than one hour.

Aims: The aim of this study was to measure the impact of prolonged case delays on the colonoscopy outcome measures of adenoma detection rate and withdrawal time.

Methods: We performed a single center cohort study including patients aged ≥50 years undergoing screening colonoscopy during a 4.5 year period. Using multivariate regression, we measured the impact of delays on adenoma detection rate and withdrawal time, adjusting for age, gender, endoscopist, time of day of the procedure, and bowel preparation quality.

Results: Of 7905 screening colonoscopies, 2503 (32%) were delayed by >1 h. On multivariable analysis, cases delayed 1–2 h were associated with a significant decrease in adenoma detection rate relative to cases delayed ≤1 h (OR 0.88, 95% CI 0.78–1.00, $p = 0.049$). Withdrawal time was not significantly associated with case delays.

Conclusions: Prolonged case delays over 1 h are associated with reduced adenoma detection rates. Future research on factors underlying prolonged delays may help mitigate these barriers to care and improve quality outcomes.

1. Introduction

Case delays impact patient satisfaction and healthcare efficiency, but prolonged delays may also impact colonoscopy quality. The adenoma detection rate (ADR) is a key quality indicator inversely associated with risk of interval colorectal cancer [1,2]. Studies have shown that various modifiable factors can affect adenoma detection and improve the quality of colonoscopy, including bowel preparation quality, withdrawal time, and cecal intubation rate [3–6]. We postulate that another important factor that may impact the ADR is delay in procedure start times.

Prior studies have investigated the association between procedure delays and ADR and found no association, though non-significant trends were seen for decreasing ADR in cases delayed over 1 h [7,8]. One study has also assessed predictors of withdrawal time and found no association with case delays [8]. The vast majority of the cases in these studies, however, were delayed less than one hour, making it difficult to extrapolate these conclusions to more prolonged case delays. Therefore, the aim of this study was to assess whether substantial delays in procedure start times impact clinical quality measures such as ADR and withdrawal time.

2. Methods

This single-center cohort study evaluated patients ≥50 years undergoing average-risk outpatient screening colonoscopy at Columbia University Irving Medical Center during the 4.5 year period from January 1, 2011 to June 30, 2015. This study was approved by the Institutional Review Board of Columbia University Irving Medical Center (approved 10/14/2015). For this type of study formal consent was not required.

The exposure was procedure delay, defined as an endoscope insertion time documented after scheduled procedure start time. Procedures were categorized into three groups based on delay times: cases early/on time or delayed ≤1 h, cases delayed 1–2 h,

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Table 1
Demographic information and classification of cases based on case delay.

Variable	Total($n=7905$)	Case delay category		
		Delayed≤1 h($n=5452$)	Delayed1–2 h($n=2003$)	Delayed>2 h($n=450$)
Time of Day n(%)				
Morning Cases	5390 (68%)	4020 (74%)	1171 (58%)	199 (44%)
Afternoon Cases	2515 (32%)	1432 (26%)	832 (42%)	251 (56%)
Mean Age	61.0 years	61.0 years	61.2 years	61.4 years
Age Range	50–91 years	50–91 years	50–87 years	50–85 years
Breakdown by Age: n(%)				
50–60	3781 (48%)	2631 (48%)	944 (47%)	206 (46%)
60–70	2729 (35%)	1867 (34%)	695 (35%)	167 (37%)
0–80	1260 (16%)	869 (16%)	326 (16%)	65 (14%)
80+	135 (2%)	85 (2%)	38 (2%)	12 (3%)
Gender: n (%)				
Female	4542 (58%)	3160 (58%)	1151 (57%)	231 (51%)
Male	3363 (42%)	2292 (42%)	852 (43%)	219 (49%)
Adenoma Detected: n(%)				
Total	1996 (25%)	1422 (26%)	471 (24%)	103 (23%)
Female	986 (22%)	708 (22%)	229 (20%)	49 (21%)
Male	1010 (30%)	714 (31%)	242 (28%)	54 (25%)
Withdrawal Time Mean in min (SD)	9.2 (4.5)	9.4 (4.4)	8.9 (4.6)	9.0 (4.8)
Total number of cases assessed: n (%)	3518	2403	931	184
<6 min	580 (17%)	338 (14%)	202 (22%)	40 (22%)
6–12 min	2106 (60%)	1497 (62%)	515 (55%)	94 (51%)
12–18 min	665 (19%)	456 (19%)	170 (18%)	39 (21%)
>18 min	167 (4%)	112 (5%)	44 (5%)	11 (6%)
Mean Delay: minutes (SD)				
Total cases	48.0 (SD 41.1)			
Morning Cases	42.8 (SD 37.4)			
Afternoon Cases	59.1 (SD 46.1)			

and cases delayed >2 h. The primary outcomes were ADR (defined as the presence of ≥1 adenoma, including any detected polyp regardless of size) and withdrawal time (defined as the time from reaching the cecum to the removal of the colonoscope from the rectum in cases without pathology). Covariates included age, gender, endoscopist, time of day of the procedure, and bowel preparation quality (considered optimal if documented as "excellent," "good," or "adequate to identify polyps" and suboptimal if "fair," "poor," "inadequate," or "unsatisfactory"). Information regarding the type of preparation regimen used prior to procedure was not reliably recorded in the medical record, and therefore not available for analysis. Morning cases were scheduled before 12 noon and afternoon cases after 12 noon. Cases with two documented attending physicians (suggesting a particularly difficult case), repeat colonoscopies for an individual patient, and cases with missing information about start times were excluded.

Cochrane-Armitage trend tests and Pearson chi-squared tests were used to assess the univariable impact of case delays on ADR. The student *t*-test was used to assess impact of delays on withdrawal time. Multivariable logistic regression was used to identify the effect of case delay on ADR, and multivariable linear regression was used to assess the associations between case delay and withdrawal time.

3. Results

A total of 7905 screening colonoscopies were assessed, including 5390 morning cases and 2515 afternoon cases. The mean patient age was 61 years, and 57.5% were female (Table 1). We identified 5402 cases that started early/on time or were delayed ≤1 h, 2043 cases that were delayed 1–2 h, and 460 cases that were delayed >2 h. Mean delay time was 48 min.

Overall ADR for all cases was 25.25%. There was no significant difference in ADR between morning and afternoon cases (25.16% versus 25.45% respectively, p value = 0.783). There was a significant decrease in the ADR with prolonged case delays, from 26% with delays ≤1 h to 23% for cases delayed >1 h ($p=0.028$, Table 2). The association of case delays with ADR remained significant when adjusted for age, gender, time of day of procedure, and preparation quality (Table 3). Given that differences in individual endoscopist characteristics could impact ADR, the model was also adjusted for endoscopist. Relative to cases delayed ≤1 h, the odds ratio for detecting an adenoma was 0.88 for cases delayed 1–2 h and 0.81 for cases delayed >2 h ($p=0.049$ and $p=0.077$ respectively).

Table 2
Univariable analysis of the impact of case delays on adenoma detection rate and withdrawal time, overall and for morning and afternoon cases. (SD, standard deviation).

Outcome	Time of day	Case delay category	Value	*P* value
Adenoma Detection Rate (%)	Total Cases	≤1 h	26.14%	0.028
		1–2 h	23.40%	
		>2 h	23.04%	
	Morning Cases	≤1 h	25.87%	0.093
		1–2 h	23.40%	
		>2 h	21.11%	
	Afternoon Cases	≤1 h	26.68%	0.2611
		1–2 h	23.68%	
		>2 h	24.30%	
Mean Withdrawal Time (minutes)	Total Cases	≤1 h	9.36 (SD 4.38)	Reference
		1–2 h	8.93 (SD 4.64)	0.0151
		>2 h	9.02 (SD 4.84)	0.3539
	Morning Cases	≤1 h	9.24 (SD 4.37)	Reference
		1–2 h	8.40 (SD 4.75)	0.0002
		>2 h	7.85 (SD 4.51)	0.0079
	Afternoon Cases	≤1 h	9.73 (SD 4.39)	Reference
		1–2 h	9.79 (SD 4.34)	0.8298
		>2 h	9.96 (SD 4.92)	0.6522

Mean withdrawal time for cases overall was 9.23 min (SD 4.48). It was 8.99 min (SD 4.49) for morning cases, and 9.77 min (SD 4.42) for afternoon cases. Case delays of 1–2 h were significantly associated with shorter withdrawal time on univariable analysis compared to delays ≤1 h as the reference group (8.93 vs. 9.36 min, $p=0.0151$, Table 2). When stratified by time of day, delays of 1–2 h and >2 h were associated with shorter withdrawal time

Table 3
Multivariable regression analysis of the impact of case delays on adenoma detection and withdrawal time, adjusted for age, gender, time of day, bowel preparation quality, and endoscopist. (OR, Odds Ratio; CI, Confidence Interval).

Outcome	Adjusted variables	Case delay category	OR	95% CI	*P* value
Adenoma Detection	Age, Gender, Time of Day, Preparation Quality	≤1 h	1		
		1–2 h	0.85	0.75–0.96	0.007
		>2 h	0.80	0.64–1.01	0.056
	Age, Gender, Time of Day, Preparation Quality, Endoscopist	≤1 h	1		
		1–2 h	0.88	0.78–1.00	0.049
		>2 h	0.81	0.64–1.02	0.077
Outcome	Adjusted variables	Case start delay group	Beta coefficient	95% CI	*P* value
Withdrawal Time (minutes)	Age, Gender, Time of Day, Preparation Quality	≤1 h	Reference		
		1–2 h	−0.57	−0.90- −0.23	0.001
		>2 h	−0.25	−0.91- −0.40	0.447
	Age, Gender, Time of Day, Preparation Quality, Endoscopist	≤1 h	Reference		
		1–2 h	−0.23	−0.52–0.06	0.113
		>2 h	−0.18	−0.75–0.39	0.534

in morning cases, but delays did not impact withdrawal time in afternoon cases (Table 2). These associations remained significant on multivariable analysis after adjusting for age, gender, time of day, and bowel preparation quality for case delays of 1–2 h, though were not longer statistically significant when endoscopist was also included in the model (Table 3).

4. Discussion

In this study, we found that case delays >1 h were associated with a significant decrease in ADR, which persisted on multivariable analysis, but were not associated with decreased withdrawal time.

This is the first study to evaluate the impact of prolonged delays on colonoscopy quality outcomes. While prior studies found no association between ADR and delays <1 h, a non-significant trend toward decreasing ADR was seen in longer delays, which is in line with our findings [8]. It is possible that prolonged delays may result in a heightened desire to "catch up," thus causing endoscopists to rush and decreasing procedure quality. Impact on withdrawal time was more pronounced in morning than afternoon cases on univariable analysis, though this was no longer significant overall once adjusted for endoscopist on multivariable analysis. Endoscopists may feel more pressure to "catch up" in morning cases, possibly because remaining caseload is higher, due to anticipation of unexpectedly difficult cases, or due to concerns of delaying a different endoscopist with an afternoon block of cases.

Our study has limitations. Cases can be delayed for various reasons, which may be patient-centered (e.g. delay in patient arrival), endoscopist-centered (e.g. complications with prior cases), and logistical (e.g. difficulties with equipment or room turnover). Unfortunately, we do not have access to data for why individual cases were delayed. Our results suggest that collecting data on such factors may be critical to future quality improvement efforts to limit delays, and in turn improve outcomes.

Furthermore, it is possible that the association between case delays and colonoscopy quality is confounded by endoscopist characteristics. Although it is not possible to eliminate confounding in this observational study, inclusion of endoscopist identity in the multivariable model did not negate the association between case delay and adenoma detection rate. The association between case delays and withdrawal time, however, was no longer significant after adjusting for endoscopist. It is possible that decreasing withdrawal time may be a compensation strategy for some endoscopists but not others. Prolonged case delays may drive a decreased ADR during delays through pathways other than withdrawal time, such as distraction or fatigue, and these factors warrant further study.

In summary, in this study we found that prolonged delays cause a reduction in ADR. Efforts to minimize these delays may result in improved colonoscopy quality and could potentially impact clinical outcomes.

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Approval

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Author contributions

Guarantor: BL
Study concept and design: ML, BL, PHRG
Acquisition of data: ML, SM, BL
Analysis and interpretation of data: ML, SM, CH, PHRG, BL
Drafting of the manuscript: ML, SM, CH, PHRG, BL
Critical revision of the manuscript for important intellectual content: ML, SM, PHRG, BL, CH
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Declaration of Competing Interest

The authors declare that they have no conflict of interest.

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