RESEARCH ARTICLE

Effect of Screen Distance on Colonic Polyp Detection and Colonic Polyp Size Estimation: A Pilot Study

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Abstract

Background

Colorectal cancer is the 3rd most common cancer in the world, with about 1.2 million new cases reported annually. It is one of the three most common causes of cancer related mortality in Europe and North America. Thus, prevention and detection are critical aspects in managing colorectal cancer. Colonoscopy remains the gold standard for screening of colorectal cancer, as it is valuable not only for detection but also prevention with polyp identification. Adenoma detection rate remains a pivotal part of a good endoscopic exam. While various factors have been known to influence it, data regarding ideal screen distance for adenoma detection remains unclear. The aim of this study was to assess the rate of polyp detection and estimate the size of diminutive (<1 cm) polyps with varying screen distance from the proceduralist.

Materials and Methods

This was a quality improvement project carried at OSF Saint Francis Medical center where post graduate trainees and attending physicians were enrolled. A 26-inch-high resolution screen was used and placed at eye level for the endoscopist. We selected 50 high resolution slides of polyps (<1 cm) intermixed with slides of normal colonic mucosa. These slides were downloaded from Orpheus Medical, a global clinical media platform and video informatics company. These were shown to each endoscopist standing either 3, 6, or 9 feet away (0.91, 1.8, or 2.7 meters) from the screen on three separate days, arranged in 3 different configurations. Both the rate of polyp detection and the sizes of polyps measured at various distances were recorded. The endoscopists were able to move +/- 10 cm (0.5 feet) from their index position to enhance their visualization and for better accommodation. The data was collected for multiple outcomes and statistical analysis was performed using odds ratio and t-test.

Results

Seven subjects who were either 3rd year Gastroenterology fellows or attendings were included in the study. We included 50 slides, with 33 consisting of polyps (<1 cm) and others containing normal colonic mucosa. Our results showed that the number of polyps detected decreased as the distance from the screen increased. Overall polyp detection rate (PDR) was 92.18% at 3 feet (0.91 m), 87% at 6 feet (1.8m) and 77% at 9 feet (2.7m). An endoscopist positioned at 3 ft had a statistically significant higher polyp detection rate than one positioned at 9 ft with odds ratio (OR) of 3.43 (95% CI: 1.45 – 8.11, p= 0.004). The mean polyp size reported by all subjects was 2.68 mm at 3 feet, 2.57 mm at 6 feet and 2.25 mm at 9 feet. Comparison of mean polyp sizes at different distances from screen did not reveal statistically significant differences. Secondary outcomes included accuracy of polyp detection, miss rate and mean overestimation rate. The participating subjects were surveyed verbally at the end of the study to assess their comfort at various distances. They reported the highest level of comfort at 3 feet (0.91m), followed by 6 feet (1.8m).

Conclusions

This quality improvement study sheds light on the importance of screen distance for polyp detection, especially in case of smaller polyps <1cm. Our results show that ideal screen distance for polyp detection should be close to 3 feet (0.91m) and ideally no more than 6 feet (1.8m). Similarly, our results also point out that polyp size may be overestimated if the examiner is too close to the screen and underestimated if the examiner is too far from the screen. We advocate standardization of screen distance from the endoscopist, so that the polyp size estimation is uniform across the board.

Keywords: Screen distance, colon, colonoscopy, polyp detection, polyp size

1. INTRODUCTION

Colon cancer is one of the three most common causes of cancer related mortality in Europe and North America. The past 4 decades have seen a substantial improvement in the incidence and mortality rate of colon cancer in the United States. The incidence in the total population has decreased by 35% since the 1990s. Population based screening has played a pivotal role in bringing down the incidence of colon cancer.[1] Colonoscopy remains the gold standard modality for evaluating the colon and is the most used screening test for colorectal cancer.[2]

Colonoscopy is not an ideal screening tool but also plays pivotal part in being a therapeutic tool for polyp detection and removal before they attain malignant potential. An important quality indicator of an adequate colonoscopy exam is adenoma detection rate (ADR).[3,4] ADR has been found to be inversely related to cancer found after a screening colonoscopy.[5] Several factors can affect ADR; these include bowel preparation, second observer, scope withdrawal time, high-definition endoscopy, timing of colonoscopy, patient position and certain endoscopic maneuvers.[6,7]

Distance from the screen can be another factor that might affect visualization of the colonic mucosa and eventually adenoma detection rate. To our knowledge, there are no guidelines or consensus on the ideal distance of an endoscopist from the monitor screen. Herein, we conducted a single center, prospective, pilot study (as part of a quality improvement project) comparing polyp detection rate and difference in polyp size estimation between various Gastroenterologists while positioned at 3, 6, or 9 feet (0.91, 1.8, or 2.7 meters) from the screen. Our hypothesis was that the positioning of the endoscopist farther away from the screen would decrease polyp detection rate.

2. MATERIALS AND METHODS

This study included 7 endoscopists (Gastroenterology attendings and 3rd year Gastroenterology fellows) as participants. This study was a part of a quality improvement project which was carried out at a single center, OSF Saint Francis Medical Center in Peoria, Illinois. The protocol did not require utilization of any patient information and therefore an IRB approval was not obtained. It was a non-profit study, and no funding was received.

2.1 MEASUREMENTS

Fifty high resolution slides of colonic mucosa were downloaded from Orpheus (‘Orpheus Medical,’ a global clinical media platform and video informatics company); 33 slides containing polyps (<1 cm) were intermixed with 17 slides of normal colonic mucosa. Histologically, 21 polyps were SSA, 8 were tubular adenoma, 4 were hyperplastic. The tested participants were positioned at 3, 6 and 9 feet (0.91, 1.8 and 2.7 meters) from the screen on three separate days. Every day, each participant was shown 50 slides in random order within a time frame of 250 seconds. The endoscopists could move +/- 10 cm (0.5 feet) from their index position for better accommodation and visualization.

Polyp detection and polyp size were measured at various distances and recorded. Polyp detection rate was calculated as proportion of the number of polyps accurately detected from the polyp containing slides.

Miss rate was calculated as the proportion of the number of polyps that were missed by endoscopists from the polyp-containing slides.

2.2 OUTCOMES

The primary endpoint was to compare the mean polyp detection rate and mean size of diminutive polyp (<1 cm) obtained at a 3-foot distance from the screen and comparing it with mean detection rate and mean size at 6- and 9-foot distance. Secondary outcomes included miss rate attained at 3 feet (0.9m) compared with that attained at 6 (1.8m) and 9 feet (2.7m).

2.3 STATISTICAL ANALYSIS

Data from all participants were combined and statistical analysis was performed using odds ratio and t-test with statistical significance defined as p value <0.05.

3. RESULTS

3.1 Polyp Detection Rate

Table 1a shows polyp detection rate for each distance category. Polyp detection rate was calculated as the number of slides with polyps that were accurately identified amongst the 33 slides containing polyps. Of the 33 slides assessed per distance (in feet), the polyp detection rate was 92.18% (30.42/ 33) at 3 feet, 87% (28.7/33) at 6 feet and 77% (25.4/33) at 9 feet. An endoscopist positioned at 3 ft had a statistically significant higher accuracy of polyp detection than one positioned at 9ft (Table 1b) with odds ratio (OR) of 3.43 (95% CI: 1.45 – 8.11, p= 0.004).

Table 1a

	At 3 feet (0.9m)	At 6 feet (1.8m)	At 9 feet (2.7m)
Mean number of polyps accurately detected +/- SD	30.42 +/- 2.76 (92.18%)	28.71 +/- 2.36 (87%)	25.42 +/- 2.87 (77.03%)

Table 1b

	Combined Odds ratio	P value (95% CI)
3ft / 6ft	1.71	0.25 (0.67 – 4.34)
6ft / 9ft	1.99	0.06 (0.94 – 4.21)
3ft / 9ft	3.43	0.004 (1.45 – 8.11)

3.2 Polyp Size

Table 2a shows the average size of a polyp estimated at various distances. Of the 33 slides assessed per distance (in feet), the mean size of polyp was 2.68 mm at 3 feet, 2.57 mm at 6 feet and 2.25 mm at 9 feet. The polyp size was reported largest at 3 feet and smallest at 9 feet; however, comparison of mean polyp sizes at different distances from the screen did not reveal statistically significant differences.

Table 2

	At 3 feet (0.9m)	At 6 feet (1.8m)	At 9 feet (2.7m)
Mean size of polyp (in mm) +/- SD	2.68 +/- 0.55	2.57 +/- 0.14	2.25 +/- 0.55

3.3 Miss rate

Miss rate was calculated based on the number of polyps that were missed out of the 33 slides containing polyps. Table 3 shows missed polyps and the miss rate for each distance category. Of the 33 slides assessed per distance (in feet), the miss rate was 8% (2.57/ 33) at 3 feet, 13% (4.28/33) at 6 feet and 23% (7.57/33) at 9 feet. The polyp miss rate was highest at 9 feet and lowest at 3 feet.

Table 3

	At 3 feet (0.9m)	At 6 feet (1.8m)	At 9 feet (2.7m)
Mean Number of missed polyps +/- SD (of 33 slides)	2.57 +/- 2.76 (8%)	4.28 +/- 2.36 (13%)	7.57 +/- 2.87 (23%)

All the endoscopists unanimously reported the highest level of comfort at 3 feet (0.9m) followed by 6 feet (1.8m).

4. DISCUSSION

Our study results are promising and support the hypothesis that positioning the endoscopist further from the screen could potentially decrease the polyp detection rate. This could specially hold true in cases of sessile serrated adenomas. When polyp detection rate was compared across the 3 distances in our study, i.e., 3, 6 and 9 feet (0.9m, 1.8m and 2.7m), the polyp detection rate progressively decreased as the distance from the screen was increased: 92.18% at 3 feet, 87% at 6 feet and 77% at 9 feet, respectively. Since most of the polyps in our study were diminutive (<1 cm), this could have led to better and more accurate visualization when the endoscopists were positioned in closer proximity to the screen. The same concept applies to the miss rate and therefore, with increasing distance, we saw a rise in miss rate. We found that polyp detection rate was ideal at around 3 feet

(0.9m) which is in concordance with the fact that resting point of accommodation and resting point of vergence for the human eye is around 2.6-3.2 feet (0.8 – 0.97m).[8,9]

A comparison of the average polyp size estimated at various distances from the screen revealed a linear decrease in the average size as the distance was increased; 2.68 mm at 3 feet, 2.57 mm at 6 feet and 2.25 mm at 9 feet. These results suggest that the polyp size can be overestimated if the endoscopist is positioned too close to the screen and underestimated if positioned too far from the screen.

Currently there are no guidelines on how to measure a polyp. Estimation of polyp size is subject to variability between different endoscopists in the absence of a standardized system.[10] Time intervals between surveillance colonoscopies are determined by the size of polyp, such as a 3-year surveillance interval for serrated and adenomatous polyps greater than or equal to 10mm, and a 5-year surveillance interval for polyps smaller than 10mm.[11] Hence, underestimating or overestimating the size of a polyp by changing the distance between the monitor and the endoscopist can have clinical implications and therefore should be taken into consideration during decision making.

To our knowledge, there are only two other studies that have been conducted so far to evaluate the impact of distance of an endoscopist from the monitor on ADR. A retrospective analysis conducted by Sohail et al on 328 patients compared ADR and polyp detection rate between 4 different endoscopy suites. Distance between the screen and the endoscopist in rooms 1, 2, 3, and 4 was 9.58 feet, 9.83, 7.5 and 7.41 feet (2.91, 2.99, 2.28 and 2.25 meters) respectively. The ADR was highest at 52.1% in room 4 (7.41 feet or 2.25 meters), and, based on the study, it was concluded that the optimum distance for endoscopy was less than 7.5 feet (2.28m).[12]

Another retrospective analysis compared polyp detection rate across 2 different endoscopy room setups, room A and room B, wherein distance between monitor and endoscopist was 219 cm (7 feet) and 147 cm (4.8 feet), respectively. Two other identical rooms (Rooms C and D) with a 190 cm (6.2 feet) distance between the monitor and endoscopist acted as control arm. The authors reported a significantly higher polyp detection rate observed in Room B (4.8 feet) compared to Room A.[6] Our study design was different as compared to the above two as we did not compare adenoma detection rate. Also, polyp size varied in above two studies while in our study polyp was limited to diminutive (< 1 cm) polyps. However, based on the above two studies and our results it could be inquired that ideal distance for polyp detection lies between 3-7 feet (0.9 – 2.13m). However, further larger studies are needed to make concrete conclusions.

Our study has the strength of being a pilot prospective study. Furthermore, we used downloaded slides instead of real time colonoscopy. This helped limit confounding factors like bowel preparation, withdrawal time, patient position, endoscopic maneuvers, time of the day, etc., and

therefore obtain a correlation strictly between PDR and distance from the screen.

There are several potential limitations of this study. First, only 3 distance categories were compared in this study, and it is possible that distance even closer than 3 feet (0.9m) could increase PDR. However, this is less likely since it would increase strain on the eyes,[8,9] overestimate polyp size, increase false positive rates. Second, because the study was conducted at a single center with a small sample size, the results might not be generalizable. Third, this study did not measure outcomes such as polyp detection time. Finally, the polyp detection accuracy or miss rate was not correlated with endoscopist experience, which could have been a confounding factor.

5. CONCLUSIONS

Our study results suggest that the distance between the endoscopist and the monitor screen can significantly affect the PDR and estimation of polyp size. Based on our study we suggest the ideal screen distance between the endoscopist, and screen lies between 3 to 6 feet (0.9 – 1.8m) for optimal polyp detection. However, the need for large sample randomized controlled trials is still imperative to determine the optimum distance and form concrete guidelines. We advocate standardization of screen distance from the endoscopist to ensure that the polyp size estimation is uniform across the board.

6. SUPPLEMENTARY TABLES

Endoscopist specific Polyp Detection

Physician	At 3 feet	At 6 feet	At 9 feet
Physician 1	31	26	22
Physician 2	27	26	25
Physician 3	32	31	22
Physician 4	32	31	27
Physician 5	26	29	25
Physician 6	33	27	30
Physician 7	32	31	27

Endoscopist specific Missed polyps

Physician	At 3 feet	At 6 feet	At 9 feet
Physician 1	2	7	11
Physician 2	6	7	8
Physician 3	1	2	11
Physician 4	1	2	6
Physician 5	7	4	8
Physician 6	0	6	3
Physician 7	1	2	6

Endoscopist specific Polyp size estimation

Physician	Mean polyp size at 3 ft	Mean polyp size at 6 ft	Mean polyp size at 9 ft
Physician 1	1.87	2.39	1.33
Physician 2	2.57	2.45	2.69
Physician 3	2.87	2.54	1.6
Physician 4	3.36	2.72	2.45
Physician 5	2.18	2.45	2.3
Physician 6	3.33	2.78	2.66
Physician 7	2.57	2.63	2.69

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