News Release

Title

Detection of colorectal neoplasms using linked color imaging: A prospective, randomized, tandem colonoscopy trial

Key Points

- **Linked color imaging (LCI) and white light imaging (WLI) provided similar adenoma detection rates (ADR). However, LCI significantly improved adenoma miss rate (AMR) even for endoscopists with high ADR.**
- **AMR in the LCI group was significantly lower, especially for diminutive and non-polypoid adenomas compared to the WLI group.**
- **LCI was potentially more useful for endoscopists with relatively low ADR using WLI.**

Summary

Ensuring the quality of colonoscopy is important for preventing colorectal cancer detected after the colonoscopy. It has been shown that the higher the adenoma detection rate (ADR), the lower the incidence and mortality of colorectal cancer. On the other hand, the adenoma miss rate (AMR) is about 10-30% even for endoscopists, which is one of the problems to be solved. Therefore, in this study, we conducted a prospective randomized controlled tandem trial compared to white light imaging (WLI) to examine its usefulness in colorectal tumor detection using linked color imaging (LCI), which is an image-enhanced observation.

780 colonoscopies performed at our hospital were included, and finally, 349 patients (89.5%) in the LCI group (LCI-WLI) and 351 patients (90.0%) in the WLI group (WLI-WLI) were analyzed. Visibility was evaluated for all identified polyps by the visibility score, and then only those suspected to be neoplastic lesions were resected. After evaluating the pathological diagnosis of the resected specimen, ADR, AMR, etc. were examined.

ADR was 69.6% in the LCI group and 63.2% in the WLI group, showing no significant difference ($P = 0.074$). However, LCI was useful for endoscopists with lower ADR in WLI (rs = 0.905). AMR was 20.6% in the LCI group and 31.1% in the WLI group, which were significantly lower in the LCI group ($P < 0.001$). In addition, AMR in small lesions (< 10 mm) and flat lesions were both significantly lower in the LCI group (23.4% vs 35.1%, 25.6% vs 37.9%; $P < 0.001$). Visibility score was significantly lower in the missed lesions, and LCI showed improvement of visibility especially in diminutive lesions (≤ 5 mm) and flat lesions. Furthermore, in a subanalysis that evaluated the differences between the surveillance colonoscopy interval recommendation (SCIR) determined only by the first observation and the true SCIR, taking into account missed adenomas in the first and second observations, based on the U.S. guideline, the rate of patients with altered SCIR was significantly lower in the LCI group than in the WLI group (12.9% vs 18.8%; $P = 0.032$).

Although both methods provided a similar ADR, LCI had a lower AMR than WLI, specifically for diminutive and non-polypoid adenomas. LCI could benefit endoscopists with lower ADR. Our findings demonstrate that LCI could help further improve the quality of colonoscopy.

Research Background

Early detection of adenomatous lesions is important in colorectal screening, because endoscopic resection of adenomas reduces the incidence and mortality of colorectal cancer. The ADR is inversely associated with the risk of interval cancer. However, ADR may be an insufficient quality indicator of colonoscopy as it does not reflect the missed lesions. In fact, even endoscopists with similar ADR have been reported to have varying AMR.

The high-resolution technique, equipment-based image-enhanced endoscopy (eIEE), does not require adjunct devices and eliminates the need for dye. This is an image processing technology that can be applied with the touch of a button on the endoscope. LCI is a new eIEE designed to enhance slight color differences (Figure 1). LCI enhances the color separation of red blood vessels and white pits, allowing similar visualization to conventional WLI. Previous reports concluded that narrow band imaging (NBI), a representative of eIEE, did not improve the ADR because of insufficient brightness and may require the operator to move closer to the mucosa for observation, which narrows the field of view.

Therefore, LCI is expected to improve the ADR and reduce the AMR. The present trial aimed to investigate the superiority of LCI over WLI for lesion detection by assessing ADR, AMR, and visibility score using tandem design in which the entire colon is observed twice by different endoscopists.

Figure 1. Representative cases of white light and linked color images of a non-polypoid, diminutive adenoma

Research Results

Per patient analysis

During the first observation, polyps were detected in 264 (75.6%) and 247 (70.2%) patients in the LCI and WLI groups, respectively, but no significant difference was found (P = 0.116). The ADR was 69.6% in LCI group and 63.2% in the WLI group, with no significant difference (RR 1.10; 95% CI 0.99-1.22; P = 0.074). In the correlation analysis of the difference of ADR by WLI, there was a strong negative correlation between the improvement ratio calculated by

LCI-ADR/WLI-ADR and ADR using WLI (rs = 0.905, $P < 0.001$) (Figure 2). We expect LCI to be potentially more useful to endoscopists with relatively low ADR using WLI, including general endoscopists.

Furthermore, in a subanalysis that evaluated the differences between the surveillance colonoscopy interval recommendation (SCIR) determined only by the first observation and the true SCIR, taking into account missed adenomas in the first and second observations, based on the U.S. guideline, the rate of patients with altered SCIR was significantly lower in the LCI group than in the WLI group (12.9% vs 18.8%; RR 0.69; 95% CI 0.48-0.97; $P = 0.032$) (Figure 3). We found that the lower miss rate of subcentimetric adenomas by LCI enables higher levels of surveillance colonoscopies compared to WLI and may reduce interval cancer.

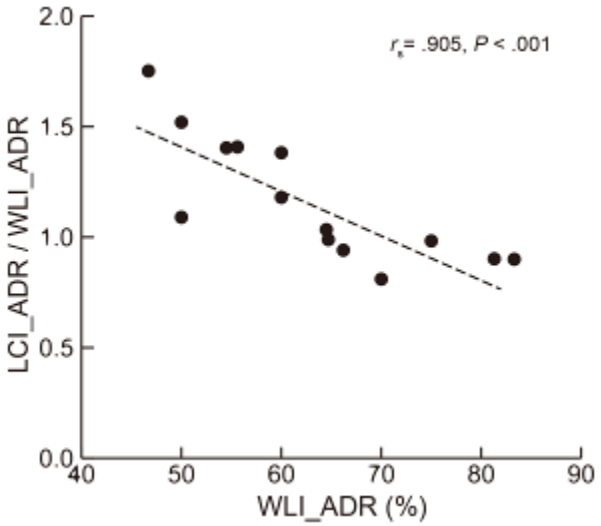

Figure 2. Correlation between ADR using WLI and incremental ratio of ADR using LCI at each endoscopist

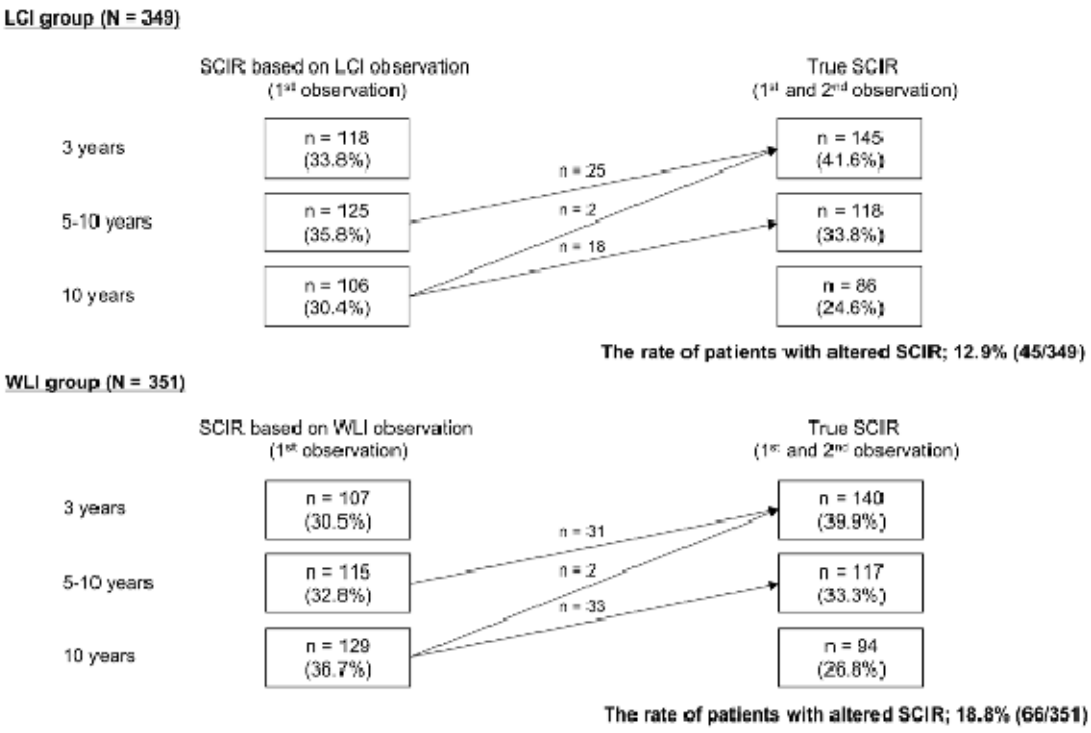

Figure 3. . Comparison of changes in surveillance colonoscopy interval recommendation based on U.S. guideline

Per lesion analysis

During the first observation, 698 polyps in 349 patients and 632 polyps in 351 patients were detected in the LCI and WLI groups, respectively. Histopathologically, 547 (78.4%) and 500 (79.1%) polyps were classified as adenomas with low-grade dysplasia and 39 (5.6%) and 33 (5.2%) as adenomas with high-grade dysplasia in the LCI and WLI groups, respectively.

The total adenomas found in the first and second observations were 738 and 774 lesions, and the missed adenomas included 152 and 241 lesions in the LCI and WLI groups, respectively (Table 1). The AMR was significantly lower in the LCI group than in the WLI group (20.6% vs 31.1%; RR 0.66; 95% CI 0.55-0.79; $P < 0.001$). In addition, the AMR for < 10 mm lesions was significantly lower in the LCI group than WLI group (≤ 5 mm: 23.4% vs 35.1%; RR 0.67; 95% CI 0.55-0.81; $P < 0.001$, 6-9 mm: 15.8% vs 25.3%; RR 0.62; 95% CI 0.39-0.99; $P = 0.043$). The AMRs for non-polypoid lesions were 25.6% and 37.9% in the LCI and WLI groups, respectively; the AMR was significantly different between the groups (RR 0.68; 95% CI 0.56-0.81; $P < 0.001$). Significant differences in the AMR were detected in a wide range of locations, including the ascending colon, transverse colon, sigmoid colon, and rectum.

	LCI group	WLI group	*P* value	RR (95% CI)
Total adenoma miss rate, % (n/N)	20.6 (152/738)	31.1 (241/774)	< .001	0.66 (0.55-0.79)
Adenoma miss rate for Size, % (n/N)				
≤ 5 mm	23.4 (127/542)	35.1 (198/564)	< .001	0.67 (0.55-0.81)
6-9 mm	15.8 (23/146)	25.3 (37/146)	.043	0.62 (0.34-0.99)
≥ 10 mm	4.0 (2/50)	9.4 (6/64)	.265	0.43 (0.10-1.77)
Adenoma miss rate for Morphology, % (n/N)				
Non-polypoid (0-IIa, IIb, IIc)	25.6 (125/488)	37.9 (204/538)	< .001	0.68 (0.56-0.81)
Polypoid type (0-Is, Ip)	10.8 (27/250)	15.7 (37/236)	.112	0.69 (0.43-1.09)
Adenoma miss rate for Location, % (n/N)				
Cecum	14.0 (7/50)	16.4 (10/61)	.728	0.85 (0.35-2.03)
Ascending colon	16.6 (32/193)	25.7 (53/206)	.026	0.64 (0.44-0.95)
Transverse colon	22.3 (47/211)	32.5 (68/209)	.018	0.69 (0.50-0.94)
Descending colon	26.3 (20/76)	35.0 (28/80)	.240	0.75 (0.46-1.21)
Sigmoid colon	26.8 (41/153)	39.3 (70/178)	.019	0.68 (0.49-0.93)
Rectum	9.0 (5/55)	30.0 (12/40)	.009	0.31 (0.12-0.75)

Table 1. Miss rate analysis of adenomas in the two groups

Visibility analysis

During the first observation, the mean visibility scores in the LCI group were significantly better than those in the WLI group (3.31 ± 0.70 vs 3.20 ± 0.74; MD 0.11; 95% CI 0.02-0.19; $P = 0.012$), specifically for diminutive and non-polypoid adenomas (Table 2). In the second observation, the mean visibility scores of adenomas were similar in both groups, except for polypoid lesions (LCI group vs WLI group: 2.93 ± 0.62 vs 3.24 ± 0.60; MD -0.32; 95% CI -0.62 to -0.01; $P = 0.042$). The mean visibility scores of missed adenomas were significantly lower in both groups compared with those of adenomas detected during the first observation.

Visibility score, mean ± SD	1st observation			2nd observation			1st vs 2nd observation, *P* value	
	LCI group	WLI group	*P* value	LCI group	WLI group	*P* value	LCI group	WLI group
AI	3.31 ± 0.70	3.20 ± 0.74	0.012	2.75 ± 0.63	2.78 ± 0.68	0.786	< 0.001	< .0001
Size (mm)								
≤ 5 mm,	3.21 ± 0.70	3.04 ± 0.70	< 0.001	2.76 ± 0.61	2.76 ± 0.68	0.938	< 0.001	< 0.001
6-9 mm	3.52 ± 0.67	3.55 ± 0.67	0.718	2.70 ± 0.77	2.84 ± 0.65	0.413	< 0.001	< 0.001
≥ 10 mm	3.65 ± 0.57	3.58 ± 0.72	0.599	2.50 ± 0.71	2.83 ± 0.98	0.650	0.007	0.025
Morphology								
Nonpolypoid	3.13 ± 0.70	3.04 ± 0.71	0.002	2.72 ± 0.63	2.69 ± 0.67	0.764	< 0.001	< 0.001
Polypoid	3.63 ± 0.55	3.65 ± 0.53	0.789	2.98 ± 0.62	3.24 ± 0.60	0.042	< 0.001	< 0.001

Table 2. Mean visibility scores of adenoma lesions classified by each observation

Research Summary and Future Perspective

The results of this study showed that LCI reduces the adenoma miss rate. However, LCI is not routinely used by many endoscopists as an alternative to regular WLI in screening colonoscopy. In the future, additional research such as including trainees, an external validation study with a multi-center, or direct comparison between LCI and other eIEE is desired.

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