Can Cap-Assisted Colonoscopy Be a Savior for Right Side Interval Cancer?

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There is no doubt that effective colorectal cancer screening relies on early identification and removal of polyps with neoplastic potential [1, 2]. Although colonoscopy is regarded as the best method for detecting colonic neoplasm, it does have limitations. Right-sided lesions, flat polyps, and variable detection of endoscopist adenoma are all reasons why polyps are missed and interval cancers develop after a negative screening colonoscopy. Successful colorectal cancer protection by colonoscopy depends on complete intubation of the colon combined with careful and complete visualization of the colonic mucosal surface on withdrawal. A large population-based study showed that failure to intubate the cecum is not uncommon, especially for less experienced endoscopists; it was estimated to occur in 13.1 % of attempted colonoscopies [3]. Furthermore, occurrence of missed adenoma ranging from 13 to 26 % has been reported [4]. Adenoma detection has been shown to be an independent predictor of the risk of interval colorectal cancer after screening colonoscopy [5]. Several types of new technology have therefore been developed to improve adenoma detection, including high-definition white-light colonoscopy, pan-chromoendoscopy, wide-angle colonoscopy, virtual chromoendoscopy, third-eye retroscopy (TER), and cap-assisted colonoscopy (CAC) [6].

CAC is a simple method in which a transparent or nontransparent rubber cap is attached to the tip of a colonoscope with an appropriate protrusion length. The cap can be readily equipped and the field of vision is not substantially affected by the cap. Although conflicting results have been reported after recent studies that compared CAC with standard colonoscopy (SC), CAC has been

reported to be associated with improved polyp detection, reduced cecal intubation time, and enhanced cecal intubation [7–10].

Theoretically, CAC can detect polyps better than SC, especially those behind semilunar folds. CAC can help depress semilunar folds, thereby reducing the blind mucosal surface area, and may improve the efficiency of adenoma detection [6]. A study of lesions missed at colonoscopy but detected by computed tomography colonography revealed that 67 % lie on the proximal side of semilunar folds [11]. The cap also keeps the tip of the endoscope a distance from the colonic mucosa, particularly around colonic bends, and provides a continuous visual field of the lumen direction. CAC seeks to reduce the percentage of the colonic mucosal surface that is left unexamined in a “complete” colonoscopy [12]. Large-scale meta-analyses have revealed that CAC improves the detection of colonic neoplasm compared with standard colonoscopy (SC) both in terms of the number of patients identified with at least one polyp and in terms of the polyp miss rate determined by tandem colonoscopy [6, 13]. It seems that CAC predominantly improves the detection of small (6–9 mm) and diminutive (5 mm) adenomas. A study of colonoscopic miss rates determined by back-to-back colonoscopies revealed the miss rate was 13 % for small adenomas and 27 % for diminutive adenomas [4]. Because up to 15.5 % of small adenomas and up to 3.4 % of diminutive adenomas contain high-grade dysplasia, it is possible that those that are missed contribute to the occurrence of interval cancers [14, 15]. In a Japanese study, adenoma detection, particularly of sessile and small adenomas, was higher in the retractable cap group than the non-cap group (29 vs. 24 %) [16]. Investigation using a colonic training model revealed that visualization of the colonic surface was significantly increased during CAC

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compared with SC, and that the improvement in visualization was only significant for the right colon, but not for the rectum, sigmoid, or descending colon [17]. Evidence supporting the efficacy of CAC for identifying colonic neoplastic lesions is accumulating continuously. The advantages of CAC in the detection of small and diminutive adenomas, particularly sessile-type right side lesions, may reduce the incidence of interval cancer.

CAC seems to facilitate cecal intubation and reduce intubation time. Two meta-analyses have shown that a higher cecal intubation rate can be achieved with CAC than SC [13, 18]. It has been speculated that less-experienced operators would obtain greater benefit from such a device [10]. Expert endoscopists have been shown to have a shorter cecal intubation time with CAC than SC [6]. A randomized controlled trial reported that the successful intubation rate for CAC was 67 versus 21 % for SC in failed colonoscopy [19]. Furthermore, CAC has been reported to reduce cecal intubation time in difficult cases, for example old age, before abdominal operation, and poor bowel preparation [20]. CAC may have a role in improving cecal intubation in a difficult or failed colonoscopy. A recent study revealed that the limited use of low-air insufflation in the rectum and sigmoid colon shortened cecal intubation time and reduced post-procedural abdominal bloating [21]. With the cap, easier anticipation of

the direction in which the colonoscope should be advanced, with less air insufflation, potentially enables more comfortable examination. The combination of these two characteristics of CAC, namely a higher cecal intubation rate and a higher rate of detection of neoplastic lesions, indicates that CAC is superior to SC as a screening tool for detection of colorectal neoplasms, especially right side lesions.

In this issue of *Digestive Diseases and Sciences*, Horiuchi et al. [22] reconfirm the efficacy of CAC in detecting neoplastic lesions compared with SC. These authors investigated 2,301 colonoscopies—1,165 CACs and 1,136 SCs—performed by four endoscopists. The authors estimated that the mean number of adenomas per subject in the control group would be 0.3 (i.e., 30 % detection). For a 30 % increase in adenoma detection with CAC, a total of at least 1,000 subjects were required in each group. There was no specific preference for CAC or SC, and there was no bias in the percentage of CAC cases performed by the four endoscopists (51, 49, 51, 51 %, $p = 0.93$). Overall, the total number of adenomas detected with CAC was significantly higher than with SC (586 vs. 484, $p < 0.0001$). Importantly, CAC significantly increased adenoma detection in the right colon compared with the left colon (19 vs. 12 %, $p = 0.0001$). This confirms the previous finding in a colonic training model that CAC significantly improves

Table 1 Randomized controlled trials comparing cap-assisted colonoscopy with standard colonoscopy

Study	Sample size		Cap length	Lesion detection	Cecal intubation rate	Cecal intubation time	Comfort
	CAC	Control					
Harada et al. [24]	289	303	2 mm	CAC = SC	CAC = SC	CAC > SC	CAC > SC
Kondo et al. [10]	221	235	2 or 4 mm	CAC > SC	CAC = SC	CAC > SC	NS
Rastogi et al. [25]	210	210	4 mm	CAC > SC	CAC = SC	CAC > SC	NI
Shida et al. [26]	174	198	4 mm	NI	CAC = SC	CAC > SC	CAC > SC
Tee et al. [27]	200	200	4 mm	CAC = SC	CAC = SC	CAC = SC	NI
de Wijkerslooth et al. [28]	656	683	4 mm	CAC = SC	CAC = SC	CAC > SC	CAC > SC
Dai et al. [29]	121	129	4 mm	CAC = SC	CAC = SC	CAC > SC for inexperienced	CAC > SC
Choi et al. [30]	114	114	4 mm	CAC = SC	CAC = SC	CAC > SC	CAC = SC
Horiuchi et al. [16]	424	411	7 mm retractable	CAC > SC	CAC = SC	CAC = SC	NI
Kim et al. [20]	150	145	10 mm	CAC > SC	CAC = SC	CAC > SC in difficult cases	CAC = SC
Tada et al. [7]	70	70	10 mm	CAC > SC	NI	CAC = SC	CAC = SC
Lee et al. [19]	499	501	NS	CAC < SC	CAC > SC in failed cases	CAC > SC	NI

CAC, cap-assisted colonoscopy; SC, standard colonoscopy; NS, not stated; NI, not investigated

CAC > SC means CAC was superior to SC: more lesions detected, higher cecal intubation rate, and more comfortable during colonoscopy compared with SC

CAC = SC means no difference between CAC and SC for the data measured

CAC < SC means CAC was inferior to SC: fewer lesions detected, lower cecal intubation rate, and more abdominal discomfort during colonoscopy compared with SC

visualization of the right colon [17]; this improved detection of right side neoplastic lesions by CAC could reduce the incidence of interval cancer. Cecal intubation rate and cecal intubation time were similar for CAC and SC in this study. This might have been because of the short length of the cap used (4 mm). According to one meta-analysis, the length of cap used can affect the rate of polyp detection. Shorter caps are better for polyp detection (2 or 4 mm), whereas longer caps (7–11 mm) are associated with faster cecal intubation [6].

Several future modalities have been designed to increase the colonic mucosal surface area exposed to the visual field; high-definition white light colonoscopy, pan-chromoendoscopy, wide-angle colonoscopy, colonoscopy in retroversion, virtual chromoendoscopy, and TER, but most of these techniques are associated with increased procedure duration, higher cost, and reduced patient acceptance. A recent multicenter trial found that TER significantly increased adenoma detection in comparison with SC [23]; the problem with this modality would be its additional cost. CAC is more practical and less expensive than TER, but TER and CAC have not yet been compared. Interestingly, no study has reported CAC with a 5–6 mm length cap. Because shorter caps may improve polyp detection and longer caps reduce cecal intubation time, medium length caps (5–6 mm) may have both advantages. Use of a cap in screening colonoscopy in this era of right side colon lesions and interval cancer is likely to increase continuously given the several advantages of CAC discussed above (Table 1).

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