Colon Capsule: Any Room for Expansion in 2016?

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Introduction

Colorectal cancer (CRC) is the third most common cancer in women and men, worldwide. Colonoscopy is a very effective tool for CRC prevention by removal of premalignant adenoma. Colonoscopy is relatively safe and colonoscopy-related severe complication is rare. However, major complication such as perforation, hemorrhage and even mortality could be induced by colonoscopy. As a consequence, colonoscopy is usually considered as an invasive and painful procedure. The fear for complication and anxiety to pain makes healthy individuals reluctant to colonoscopy, therefore, screening rate for CRC are still remain below target. Another weak point of colonoscopy is the possibility of incomplete examination. Factors such as poor bowel preparation, redundant or tortuous colon, acute angulation, and obstruction can induce failed cecal intubation. Completion rate of colonoscopy was reported as 91.1%.

Colon capsule endoscopy (CCE) is a noninvasive technique to provide diagnostic image of colon. Second generation of CCE (PillCam-Colon2, Given Imaging Ltd., Yoqneam, Israel) is now available, providing wider angle of view. It does not require air inflation or sedation, allows minimally invasive and painless colonic evaluation. European Society of Gastrointestinal Endoscopy (ESGE) suggested that CCE can be applied for CRC screening in average-risk patients, in patients with an incomplete colonoscopy, in patients refusing a conventional colonoscopy or in patients who have contraindication for conventional colonoscopy.

In this present paper, we comprehensively review the previous literature and discuss about potential application and future expansion of CCE.

Current status of CCE

1. Technical characteristic of CCE

The novel capsule, PillCam Colon 2, is 31.5 X 11.6 mm in size and have two cameras with 172° angle of view, covering almost 360° of the colon. CCE has bidirectional communication system with data recorder. CCE has adaptive frame rate from 4 images per second when stationary to 35 images per second while in motion, which enhances visualization of colon and saves battery. The resolution of CCE image is below 0.1mm and magnification scale is up to 8. Additional software helps to enhance visualization and estimate the
characteristics of detected lesion.

2. Procedure of CCE

Adequate bowel preparation is crucial for successful CCE. Even small amount of fecal material could interrupt with identifying colonic polyps. Additionally, colon preparation is important to promote capsule propulsion and excretion. Preparation solution fills the lumen with clear fluid and distends colonic wall, and this allows close observation of colonic mucosa and facilitates capsule propulsion.

For successful CCE, subjects are recommended to begin low residue diet two days before CCE, and clear liquids diet the day before CCE. In previous studies, the regimen including PEG solution and boosts with sodium phosphate showed satisfactory bowel preparation. Split regimen of PEG on the evening before exam and in the morning of the exam is usually preferred. Boosters are required for capsule excretion and completion of the exam. Sodium phosphate booster is effective to accelerate transit time. There have been concerns about sodium phosphate toxicity such as acute kidney injury and electrolyte imbalance, other boosters like ascorbic acid and magnesium citrate were investigate, however, resulted in low capsule excretion rate and completion rate. Currently, low volume of sodium phosphate is used as booster, 40ml of sodium phosphate with 1L of water to be taken when the capsule has reached the small bowel and 20ml of sodium phosphate with 500mL of water 3 hours later after first boost. Also, additional administration of supplement agent is introduced, for example, prokinetics for delayed gastric emptying and suppository in case of delayed capsule expulsion.

3. Comparison with conventional method

Several studies compared accuracy of CCE to conventional colonoscopy. Two prospective studies reported sensitivities and specificities ranged from 84%-89% and 64%-76%, respectively, for detection of significant polyp (≥ 6 mm or ≥ 3 polyps).

In the setting of incomplete colonoscopy, alternative method to evaluate non-visualized colon is needed. CCE was proven to be able to provide additional findings such as carcinoma, inflammatory bowel disease (IBD), telangiectasia and others that might influence treatment decision. When compared CCE to CT colonography, CCE and CT colonography exhibited comparable efficacy in completing colon exam. However, the diagnostic yield of CCE was superior to CT colonoscopy and CCE seemed to be more tolerable than CT colonoscopy.

4. Contraindication for CCE and safety issues

Contraindications for CCE are similar to those of small bowel capsule endoscopy. CCE should not be done in patients with swallowing disorder because of the risk for aspiration. Due to microwaves transmitted by CCE, pregnancy is considered as a contraindication for CCE. Known or suspected bowel obstruction or stricture is another contraindication that CCE should be avoided for the risk of CCE retention. MRI should be examined after CCE is discharged from the gastrointestinal tract. There is no interference between CCE and cardiac pacemaker or implantable cardiac defibrillators, CCE could be done in patients with those devices.
Future expansion of CCE

1. Screening modality for CRC detection

CCE might have potential role as filter test. Fecal occult blood test was proven to be useful screening tool, however, false positive rate is relatively high. It induces economic burden and has potential risk for colonoscopy-related complication. In a recent trial, CCE was proven to be an effective for detecting cancer and polyps in individuals with a positive fecal occult blood test and reducing unnecessary conventional colonoscopy by 71%. To establish the role of CCE in CRC screening, large prospective trials involving hundreds of participants are now on progress in Europe (CCANDY trial in Italy and ORCA trail in the Netherlands).

Performing colonoscopy immediately after CCE has several merits, because patients do not have to repeat bowel preparation. To establish this process, several conditions are required. First, the system that review results of CCE in a short time is needed to determine the necessity of conventional colonoscopy in a same day. Another issue is colon transit time of CCE should be homogenous and relative short to predict timing of conventional colonoscopy. As colon transit time has high level of individual variation with current bowel preparation regimen, a new regimen with adequate cleansing level and transit time is desirable.

2. Diagnosis and surveillance of inflammatory bowel disease

Use of CCE in patients with inflammatory bowel disease has insufficient data. Possible position of CCE in the territory of IBD is monitoring mucosal healing in the course of disease activity monitoring. Several studies have examined the role of CCE in the assessment of mucosal inflammation. According to the previous report, the sensitivity and specificity of first generation CCE for detecting active ulcerative colitis was 89% and 75%, respectively. Some other studies reported that CCE is safe but CCE is insufficient to replace conventional colonoscopy for the assessment of disease extent and activity. Considering these previous results, ESGE guideline recommended that second generation CCE may be useful for monitoring of mucosal inflammation in patients with ulcerative colitis.

Conclusions

CCE has some shortcomings compared with conventional colonoscopy, for example, inability to take biopsy samples and to predict histology during the examination. Also, it is not economic, considering that the average cost of a CCE estimated approximately at $950 in USA and €700 in Europe. CCE is considered as a complementary test because diagnostic accuracy is still under that of conventional colonoscopy.

Beyond these limitations, CCE appears to be a promising new modality for colonic evaluation. It is noninvasive and painless modality that directly monitor the colonic mucosa. CCE could give additional information in the case of incomplete colonoscopy, in case of patients unwilling to perform a colonoscopy, or in case of patients unable to perform colonoscopy. CCE is well tolerated by patients and could be done even in outpatients setting, consequently, could raise patients’ compliance. Sensitivity of second generation CCE for polyp detection has been markedly improved when compared to first generation CCE. Considering the fast developing technologies, future of CCE is promising in the area of CRC screening for the detection of polyps.
and adenomatous lesions as well as for monitoring inflammatory bowel disease.

References