

Virtual Colonoscopy (CT Colonography)

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EXTRACT

Virtual Colonoscopy (VC) is a medical imaging procedure which combines the use of series of images, produced from multislice CT or MRI, and high-power computer to reconstruct 2D and 3D images of the colon, from rectum to ileocecal valve. With the appropriate workstation and software programs, these images are displayed dynamically, allowing radiologists to conduct virtual examination of the entire colon, simulating the way endoscopists view the colon. At current time, VC using multislice CT is used more widespread than MRI and this technique is also called CT colonography (CTC). In this article, virtual colonoscopy based upon multislice CT will be discussed and the term CT colonography (CTC) will be applied interchangeably with virtual colonoscopy (VC).

Key words : virtual colonoscopy, CT colonography

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CT Colonographic Technique

1. Bowel Preparation:
 - a. Soft and liquid diets with no meat, fruits or vegetables 48 hrs prior to the study
 - b. Oral Na phosphate (45-90 ml) and Bisacodyl (10 mg), an evening prior to the study
2. Insert rectal tube
3. Buscopan 20 mg IV before air insufflations
4. Insufflate room air via rectal tube until patient feels uncomfortable (approximately 40 puffs)
5. Scan from diaphragm to symphysis pubis in both supine and prone using thin collimation with overlapping reconstruction

6. Interpretation via workstation which consists of 3D endoluminal view, using fly-through technique both antegrade and retrograde fashions and 2D multiplanar reformations (MPR) in axial, sagittal and coronal views

Indications for CT Colonography

1. Failed/incomplete optical colonoscopy
2. Medical unsuitable for optical colonoscopy
3. CA colon staging/search for synchronous lesions
4. First-line colorectal screening (still a controversial issue)⁽¹⁻³⁾

CT Colonographic Findings

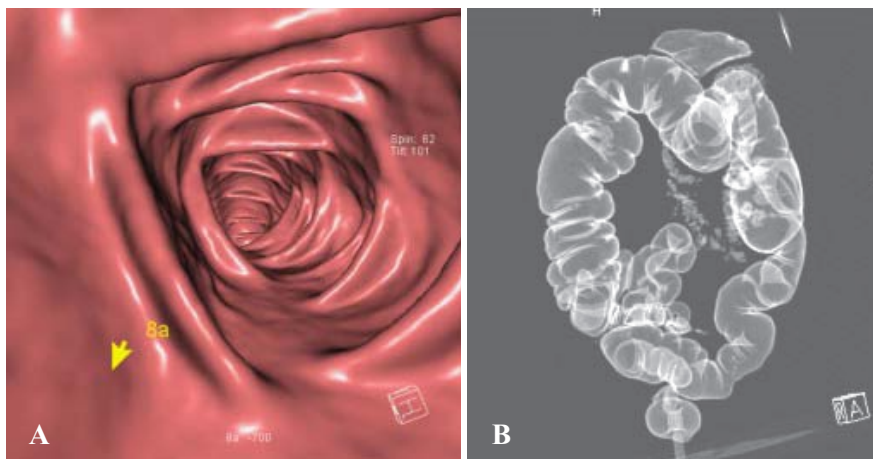
Normal Colon (Figure 1)

Pseudolesions (Figures 2-5) Pseudolesions that mimic polyps include fecal material, air bubbles, bulbous/complex folds and prominent IC valve⁽⁴⁾. Fecal material tends to trap air, has irregular shape and changes positions from supine to prone. Air bubbles are clarified by using wide window on 2D views showing an air density, which differs from soft-tissue attenuated polyps. Both bulbous/complex folds and IC valve are distinguished from polyps by using combination of multiple views. Normal IC valve can be prominent and should not be confused with polyp. However, prominent asymmetry of the IC valve should raise suspicion for a true polyp⁽⁴⁾.

Pathology

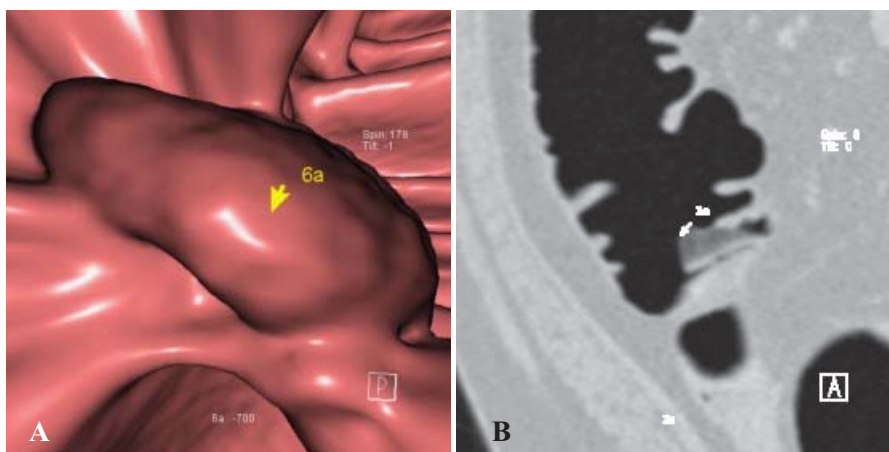
Diverticulosis/diverticulitis (Figures 6-7) On 3D views, diverticulosis may mimic a small polyp. The dark ring around the lesion defines the diverticulosis. Moreover, on 2D views diverticulosis is an air-containing pouch, totally different from polyp. Diverticulitis is an inflammation of diverticulosis and sometimes very difficult to differentiate from cancer. Clinical history, findings and evidence of diverticulosis in the adjacent colon may help distinguishing these two entities. Optical colonoscopy with biopsy may eventually require in a difficult case.

Polyps (Figures 8) Polyps appear oval or round shape. If it is pedunculated, a stalk may be identified. CTC is very sensitive for polyps of 8 mm or larger and



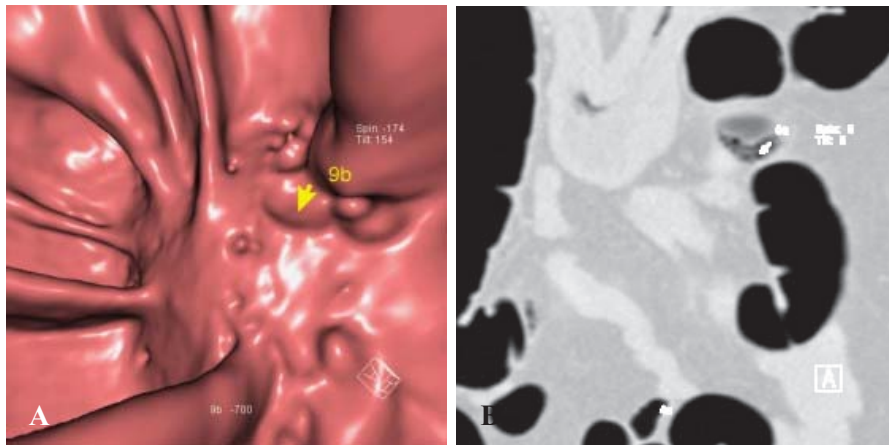
Figures 1 Normal Colon

- A 3D endoluminal view shows normal transverse folds
- B 3D volume rendering technique (VRT) with transparency similar to barium enema



Figures 2 Pseudolesion - feces

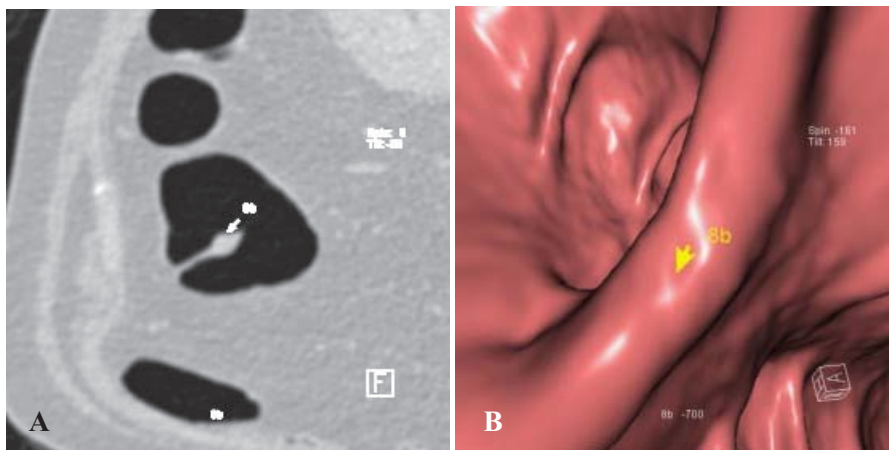
- A 3D endoluminal view shows irregular shaped feces
- B 2D coronal view shows low attenuation suggestive of air trapped within feces.



Figures 3 Pseudolesion -air bubbles

A 3D endoluminal view shows multiple air bubbles, resembling polyps.

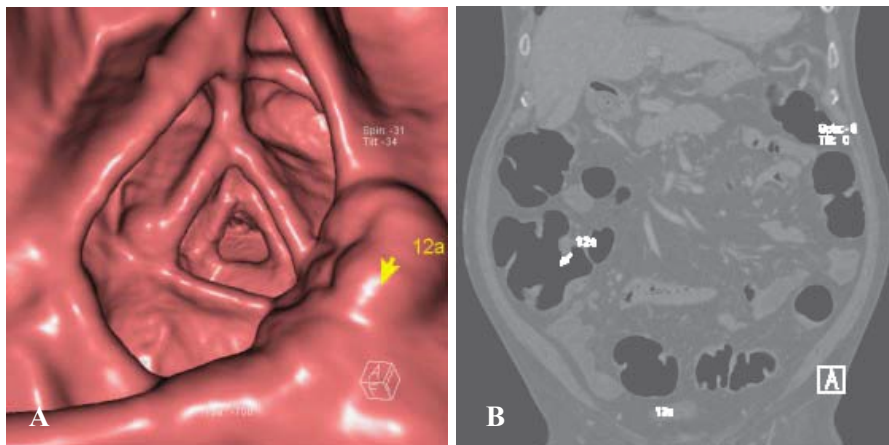
B 2D coronal view confirms air bubbles. Air attenuation is easily recognized on 2D view.



Figures 4 Pseudolesion -bulbous fold

A 2D axial view shows thickened fold, mimicking a polyp.

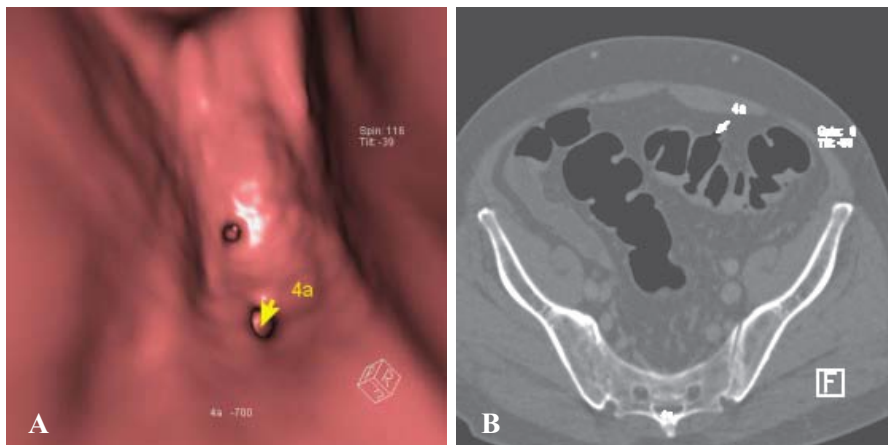
B 3D endoluminal view confirms a thickened fold.



Figures 5 Pseudolesion -prominent IC valve

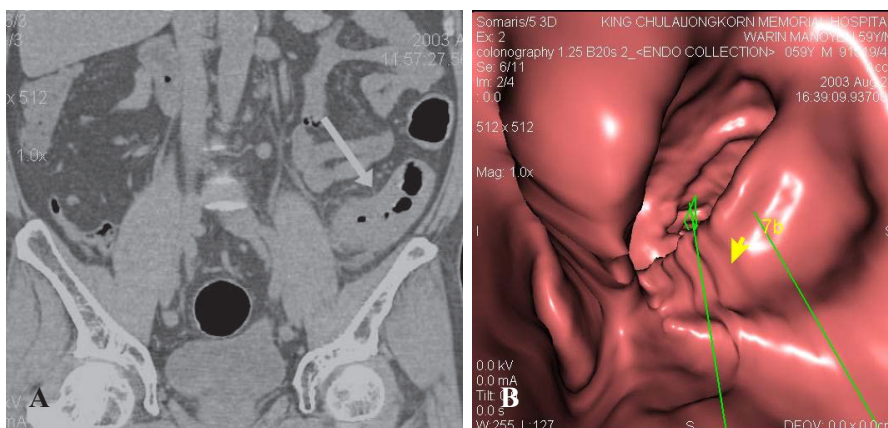
A 3D endoluminal view shows prominent IC valve.

B 2D coronal view confirms the location of prominent IC valve.



Figures 6 Diverticulosis

- A 3D endoluminal view shows two diverticula. Note dark ring surrounding each mouth, characteristic of diverticulosis.
- B 2D axial view confirms a diverticulum, which is partially obliterated by the arrow.



Figures 7 Diverticulitis

- A 2D coronal view shows a diffused, thickened wall of the sigmoid colon (arrow). Because of high degree luminal narrowing and inability to exclude cancer, surgery was performed and proved that the lesion was a segment of diverticulitis.
- B 3D endoluminal view shows thickened folds secondary to inflammation.

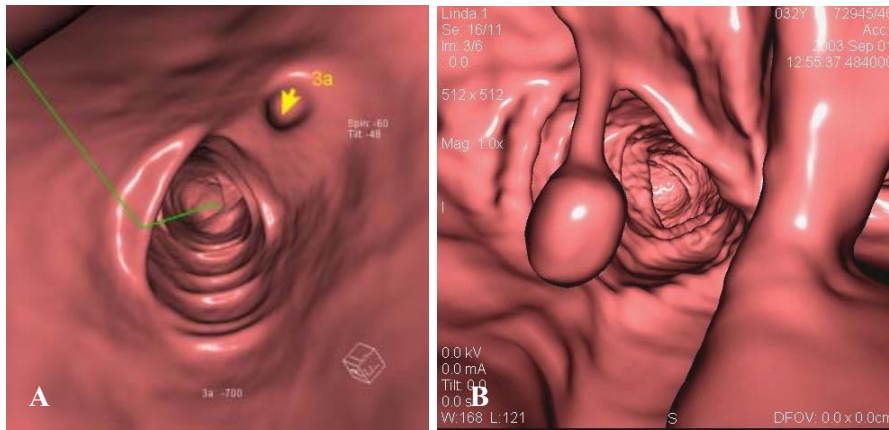
moderately sensitive for polyps of 6 mm or larger^(1,5-9). Even though small polyps of 5 mm or less are easily missed by CTC, these polyps are mostly benign and likely to be hyperplastic polyps. Chance of these tiny polyps being malignant is very small, estimated to be of less than 0.01%⁽¹⁰⁾.

Carcinoma (Figures 9) CTC is a good modality for evaluation of cancer that obstructs the lumen, which prevents the access for endoscopic instrument. CTC needs only air to distend the colon and most air can seep through a very tight stricture or narrowed lumen, allowing evaluation of the proximal colon. More-

over, staging of the lesion can be performed at the same time^(11,12). Evidence of metastasis is easily detected and will help guiding management.

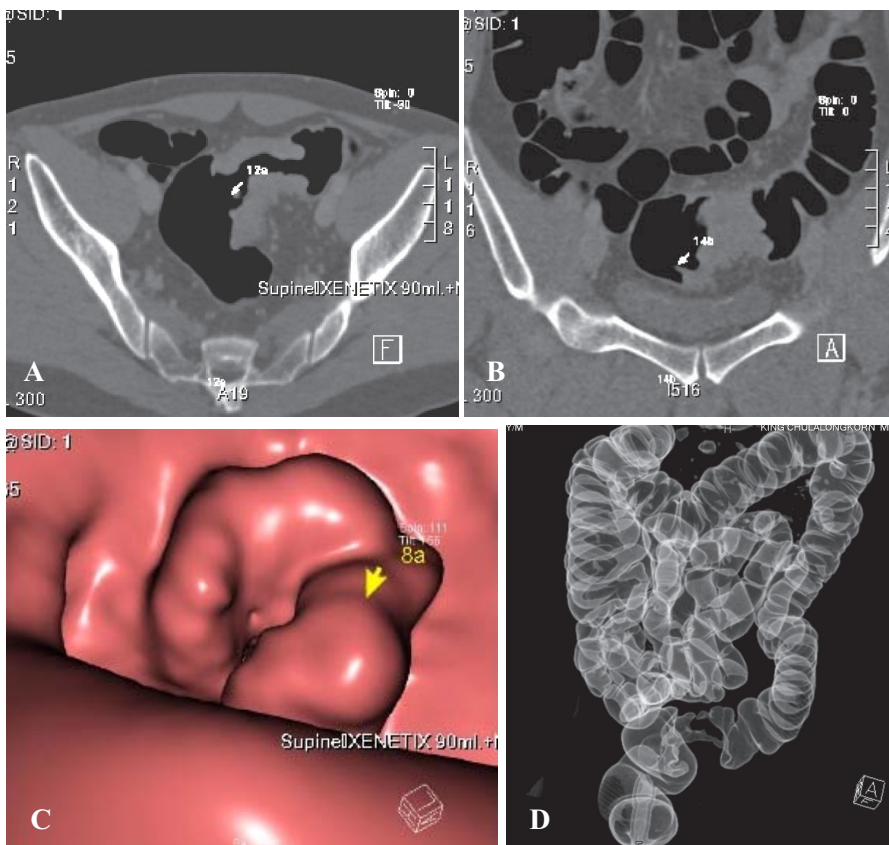
Virtual Colonoscopy (VC) versus Optical Colonoscopy (OC)

The advantages of VC include speed, high sensitivity, minimally invasive, and no sedation required. However, the inability to perform intervention, if the lesion is detected, is a drawback. At the current time, bowel preparation for VC is similar to OC and most patients do not like the experience of bowel cleansing.



Figures 8 Polyps

- A 3D endoluminal view shows a small sessile polyp of less than 5mm, which is likely to be a benign hyperplastic polyp.
- B 3D endoluminal view shows a pedunculated polyp which is proved to be an adenomatous polyp



Figures 9 A, B: CA rectum

- A 2D axial view shows a circumferential mass encasing and narrowing sigmoid colon
- B 2D coronal view shows cancer blocking the lumen of sigmoid colon. Sigmoidoscope could not pass through the obstructed lumen.
- C 3D endoluminal view shows a lobulated mass within the sigmoid colon.
- D 3D VRT view reveals circumferential narrowing of sigmoid colon, similar to the traditional double contrast BE.

Stool tagging with 2% barium orally helps increased sensitivity and specificity for polyp detection, but not eliminating the unpleasant regimen of bowel preparation⁽¹³⁾. Radiation is always an issue for CT colonography, particularly if CTC is considered for a widespread mass screening. Fortunately, the risk of developing cancer as a result of exposure to radiation during CTC is considerably small. Estimated lifetime cancer risk associated with radiation exposure for a 50-year-old person was about 0.14%, much less than CT-based lung cancer screening⁽¹⁴⁾. The radiation risk can be further reduced by creating optimized protocol, such as decreasing the effective mAs from 100 in supine view to 40 in prone view. This technique can reduce radiation dose without significantly degrading imaging information.

With advance in imaging technology, it is likely that VC will become a first-line colorectal screening. But even if that occurs, OC will never become obsolete, because there will always be patients who prefer the “one-stop shopping” offered by OC, of which screening, diagnosis and treatment are performed in one procedure.

REFERENCES

- Pickhardt PJ, Choi JR, Hwang I, *et al.* CT virtual colonoscopy to screen for colorectal neoplasia in asymptomatic adults. *N Engl J Med* 2003; 349: 2191-200.
- Johnson CD, Harmsen WS, Wilson LA, *et al.* Prospective blinded evaluation of computed tomographic colonography for screen detection of colorectal polyps. *Gastroenterology* 2003; 125: 311-9.
- Cotton PB, Durkalski VL, Pineau BC, *et al.* Computed tomographic colonography (virtual colonoscopy): a multicenter comparison with standard colonoscopy for detection of colorectal neoplasia. *JAMA* 2004; 291: 1713-9.
- Pickhardt PJ. Differential diagnosis of polypoid lesions seen at CT colonography (virtual colonoscopy). *Radio Graphics* 2004; 24: 1535-59.
- Hara AK, Johnson CD, Reed JE, *et al.* Detection of colorectal polyps with CT colonography: initial assessment of sensitivity and specificity. *Radiology* 1997; 205: 59-65.
- Dachman AH, Kuniyoshi JK, Boyle CM, *et al.* CT colonography with three-dimensional problem solving for detection of colonic polyps. *Am J Roentgenol* 1998; 171: 989-95.
- Fenlon HM, Nunes DP, Schroy PC 3rd, *et al.* A comparison of virtual and conventional colonoscopy for the detection of colorectal polyps. *N Engl J Med* 1999; 341: 1496-503.
- Miao YM, Awad-El-Kariem FM, Franzen C, *et al.* A prospective single centre study comparing computed tomography pneumocolon against colonoscopy in the detection of colorectal neoplasms. *Gut* 2000; 47: 832-7.
- Yee J, Akerkar GA, Hung RK, *et al.* Colorectal neoplasia: performance characteristics of CT colonography for detection in 300 patients. *Radiology* 2000; 219: 685-92.
- Ferrucci JT. Colon cancer screening with virtual colonoscopy: promise, polyps, politics. *Am J Roentgenol* 2001; 177: 975-88.
- Filippone A, Ambrosini R, Fuschi M, *et al.* Preoperative T and N Staging of colorectal cancer: accuracy of contrast-enhanced multi-detector row CT colonography-initial experience. *Radiology* 2004; 231: 83-90.
- Chung DJ, Huh KC, Choi WJ, *et al.* CT colonography using 16-MDCT in the evaluation of colorectal cancer. *Am J Roentgenol* 2005; 184: 98-103.
- Pickhardt PJ, Choi JR. Electronic cleansing and stool tagging in CT colonography: advantages and pitfalls encountered with primary three-dimensional evaluation. *Am J Roentgenol* 2003; 181: 799-805.
- Brenner DJ, Georgsson MA. Mass screening with CT colonography: should the radiation exposure be of concern? *Gastroenterology* 2005; 129: 328-37.