

# CT-colonography or colonoscopy

## Virtual colonoscopy

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### Abstract

CT colonography, also known as virtual colonoscopy (VC), is a noninvasive test for the examination of the colon. The technique is easy, less labour-intensive than barium enema and conventional colonoscopy and is inherently safer since no adverse event or procedure-related complications have ever been reported.

The success rate of VC is approximately 100%, if bowel preparation and distension are optimal and no sedation is required. From the patient's perspective, the major advantages of VC include the very brief time required to perform the examination, the absence of contrast enemas and the potential for same-day colonoscopy when polyps are detected. To date several studies have reported sensitivity and specificity comparable with conventional colonoscopy in the detection of clinically significant polyps. However, the smaller the polyp size, the lower the sensitivity. The currently accepted clinical uses include the evaluation of patients who have undergone unsuccessful or incomplete conventional colonoscopy, patients with obstructing colorectal cancer, and those whose medical problems make them unsuitable for conventional colonoscopy. Current uses generally do not include the screening of asymptomatic persons, although recently published work has demonstrated no statistically significant differences between VC and conventional colonoscopy regardless of polyp size. A practical approach is to consider virtual colonoscopy 'as a currently credible alternative screening method and as a reasonable alternative to the other colorectal cancer screening tests when a patient is unable or unwilling to undergo conventional colonoscopy'.

### Virtual colonoscopy

CT colonography, also known as virtual colonoscopy (VC), is a noninvasive test for the examination of the colon.<sup>1</sup> The technique is extremely easy and it is less labour-intensive than barium enema and conventional colonoscopy. Following the same meticulous bowel preparation as conventional colonoscopy,<sup>2</sup> the colon is inflated with air or carbon dioxide using a rectal tube.

Carbon dioxide produces less discomfort than conventional colonoscopy but is more expensive.<sup>3</sup> No sedation is required. The use of iodine contrast medium administration is still under debate. It is certainly necessary in patients with known or under surveillance for colorectal cancer (for detection of extra-colonic findings, i.e. liver metastases), whereas it is questionable in asymptomatic subjects. Some authors<sup>4,5</sup> propose a routine use of iodine contrast medium injection based on the evidence of a variable degree of enhancement of benign polyps and carcinoma, which might help in some cases in differentiating these solid lesions from residual colonic fluid; these data need further confirmation.

The patient is scanned in a single 15 to 30 second breath-hold in the prone position. The patient is then turned supine, and the scan is repeated.<sup>6</sup> A main technical advance in the procedure is represented by the introduction of multislice CT scanners, which provide higher resolution as well as faster acquisition.<sup>7</sup> Low-dose protocols also minimise radiation exposure.<sup>8</sup> The acquired volumetric dataset is post-processed on dedicated workstations using commercially available software programs. Image analysis is performed using a primary 2D or 3D approach (i.e. scrolling through axial slices and multiplanar reformatted images on the workstation and using 3D endoluminal views as problem-solving support, or using 3D endoluminal view as a primary approach for lesion detection) (Figure 1).<sup>9-11</sup>

To date, several studies have reported high sensitivity and specificity of VC in the detection of colonic neoplasms – not only large colonic carcinomas, but also polyps. If a threshold size of 10 mm is considered, the detection rate is comparable with conventional colonoscopy (Figure 2). The literature supports the assumption that the smaller the polyp size, the lower the sensitivity. Indeed, sensitivities between 11% and 55% for polyps smaller than 5 mm have been reported.<sup>12-17</sup>

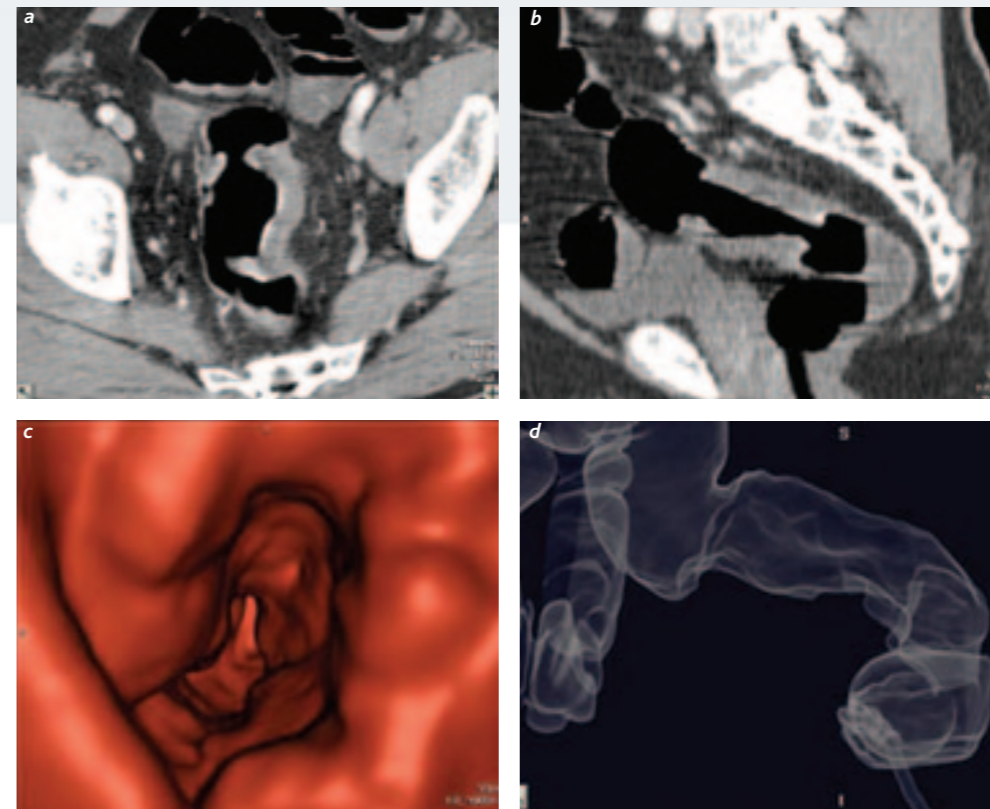
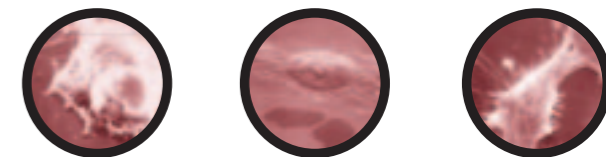


Figure 1. Sigmoid carcinoma. Colonic dataset in a case of sigmoid carcinoma can be presented using different types of images which offer a clear evaluation of the morphology as well as length of the stricture: (a) contrast-enhanced 2D axial slice, showing irregular and severe thickening, referred to sigmoid carcinoma; (b) sagittal multiplanar reformatted image of the same lesion; (c) endoluminal, 'endoscopic-like' view, showing irregular stricture; (d) 'virtual' double contrast enema.

Most studies of VC have involved patient populations with a high prevalence of colonic neoplastic lesions (symptomatic patients or patients with a moderate-to-high risk of colonic neoplasia). In the few studies on asymptomatic subjects (i.e. screening populations), a wide range of sensitivities as well as high inter-observer variability have been reported, raising doubts about the possible use of VC as a colorectal screening method. Factors such as inadequate preparation of the colon, software performance, the level of experience of the radiologist, and operator dependence affect its performance and reproducibility.<sup>18-20</sup>

### Clinical uses of VC

The currently accepted clinical uses of VC include the evaluation of patients who have undergone unsuccessful or incomplete conventional colonoscopy (colon redundancy, patient intolerance to the procedure, muscular spasm not resolved with spasmolytics),<sup>21</sup> patients with obstructing colorectal cancer,<sup>22,23</sup> and patients whose medical problems make them unsuitable for conventional colonoscopy.



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Dr Laghi has been awarded by the Italian Radiological Society (1996 & 2003) and European Society of Gastrointestinal and Abdominal Radiology (1997), and was the winner of the Mallinckrodt Research Grant (Research & Education Fund, European Congress of Radiology 2001).

Research activity includes liver imaging, CT colonography, MR cholangiography, and MR liver-specific and lymph node-specific contrast agents. Dr Laghi has presented 112 lectures to national and international congresses, 150 lessons to didactical courses, and has authored 274 printed papers, including 49 for peer-reviewed international journals.

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### Virtual colonoscopy *continued*

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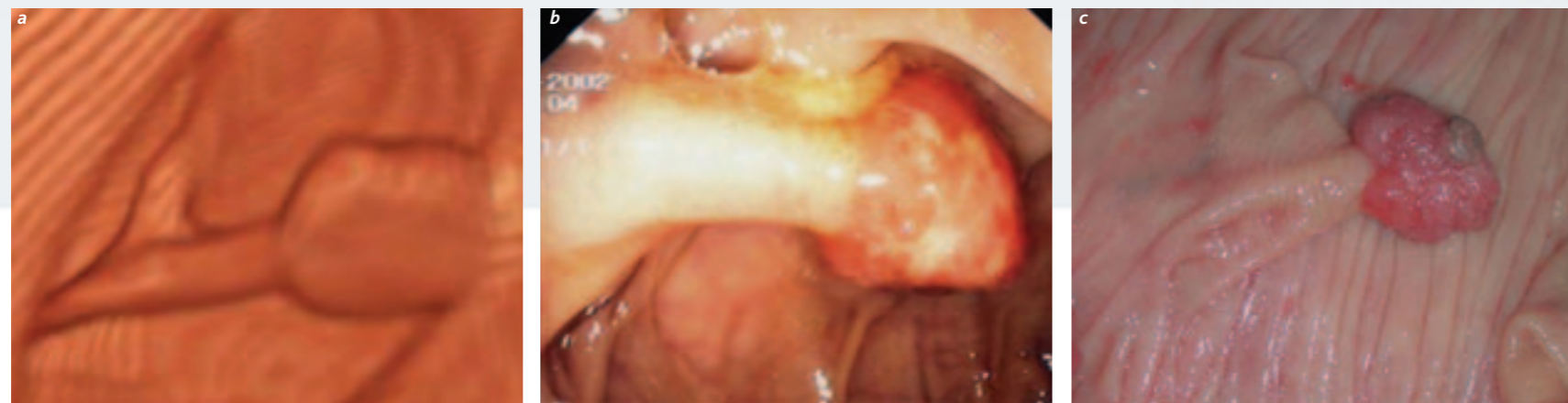
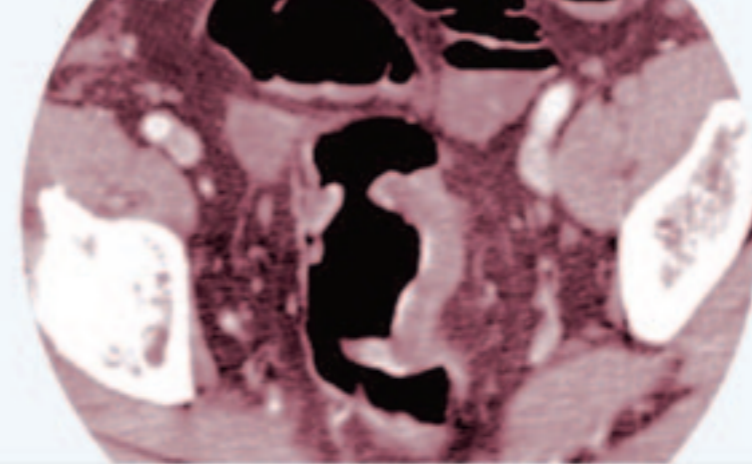


Figure 2. Comparison between (a) virtual colonoscopy, (b) conventional colonoscopy and (c) resected specimen in a case of pedunculated colonic polyp.

In cases of unsuccessful or incomplete conventional colonoscopy, the retained air from colonoscopy makes barium enema unfeasible, but it is no impediment to the performance of virtual colonoscopy to complete the colon. In patients with obstructing colon cancer, VC is technically easier than barium enema and is very cost-effective because it allows simultaneous staging of the cancer and imaging of the colonic lumen proximal to the cancer for synchronous lesions.

#### VC and colorectal cancer screening

Current uses of VC generally do not include the screening of asymptomatic persons, as also suggested by the American Cancer Society<sup>24</sup> and the American Gastroenterological Association,<sup>25</sup> both of which decided that it should not yet be used for colorectal cancer screening, because data on true screening populations are missing.

Recently, Pickhardt and colleagues<sup>26</sup> reported the largest prospective study of VC: a colorectal screening test in comparison with conventional colonoscopy. A segment-by-segment comparison was performed allowing the calculation of respective sensitivity and specificity for both the techniques in asymptomatic subjects with a 3.9% prevalence of adenomas larger than 10 mm.

No statistically significant differences were observed between VC and conventional colonoscopy regardless of polyp size (minimum size 6 mm).

VC is inherently less invasive and safer than conventional colonoscopy, with no adverse event or procedure-related complications ever reported. The success rate approximates 100%, if bowel preparation and distension are optimal, whereas up to 6% of conventional colonoscopy cannot reach the caecum.<sup>27</sup> No sedation is required – a major factor if dealing with old, unstable patients – or screening of asymptomatic subjects who would like to be able to return to work immediately after the procedure.

From the patient's perspective, major advantages of VC include the very brief time required to perform the examination, the absence of barium contrast enemas and the potential for same-day colonoscopy when polyps are detected. The latter issue requires a complex collaboration between endoscopy and radiology schedules, but it must be considered that in a screening setting approximately 70–85% of colonoscopies identify no clinically significant pathology.<sup>28</sup> The theoretical rise in cost due to the 15–30% of patients with polyps to be removed, who undergo a double

colonic examination (VC and interventional colonoscopy), is economically counterbalanced by the avoidance of 70–85% of unnecessary diagnostic colonoscopy.

In terms of patient acceptability, mixed results have been reported, with some studies showing a clear preference for conventional colonoscopy, while some demonstrate no real patient preference, and others a clear preference for virtual colonoscopy.<sup>29–31</sup> The differences among these studies were due to several reasons: sedated or unsedated conventional colonoscopy; study population (i.e. symptomatic or asymptomatic subjects); scheduling of VC and conventional colonoscopy; patients' awareness of the therapeutic capabilities of conventional colonoscopy; and type of bowel preparation. It is clear that if conventional colonoscopy is performed under sedation, the major limitation is represented by bowel preparation, independently of the cleansing agent. A real advantage of VC will come when an examination without bowel cleansing is feasible. To date there are several ongoing studies trying to assess the use of oral contrast agents (either barium, or iodine) to mark stool and to electronically remove them using dedicated software. Results on larger series are under evaluation.<sup>32,33</sup>

#### Economic analysis of VC

A detailed economic analysis about the cost of VC has yet to be performed. Sonnenberg and colleagues<sup>34</sup> calculated that virtual colonoscopy must be 54% less expensive than conventional colonoscopy and performed at 10-year intervals to have equal cost-effectiveness to conventional colonoscopy. However, this analysis did not consider the indirect costs of conventional colonoscopy, which is an important limitation. Moreover technical advances (i.e. faster patient scanning, more powerful workstations, computer assisted diagnosis) will reduce both examination and interpretation times thus improving cost-effectiveness.

A possible advocated advantage of VC is the detection of extra-colonic findings, observed in about 11% of patients.<sup>35</sup> Most of these findings are of minor relevance, although they may induce indirect cost due to imaging follow-up. Careful cost analysis as well as impact on patient outcome should be considered.

#### Conclusions

In conclusion, VC is a reliable technique for the detection of colonic disorders. It can safely replace double-contrast barium enema as a radiological tool for colonic evaluation. Current clinical indications include the evaluation of patients who have undergone unsuccessful or incomplete conventional colonoscopy, patients with obstructing colorectal cancer, and patients whose medical problems make them unsuitable for conventional colonoscopy. The use of VC as a colorectal cancer screening method cannot be recommended to date. A practical approach is to consider VC 'as a currently credible alternative screening method and as a reasonable alternative to the other colorectal cancer screening tests when a patient is unable or unwilling to undergo conventional colonoscopy' (from 'Consensus Statement' of the 4th International Symposium on Virtual Colonoscopy, Boston, MA, October 2003).

# CT-colonography or colonoscopy

## Virtual colonoscopy *continued*

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### Key Learning

Virtual colonoscopy:

- Is a noninvasive, safe and easy procedure not requiring sedation
- Is less labour-intensive than barium enema and conventional colonoscopy, and is quicker for patients
- Has high sensitivity and specificity in the detection of colonic neoplasms
- Is indicated for the evaluation of:
  - patients who have undergone unsuccessful or incomplete conventional colonoscopy
  - patients with obstructing colorectal cancer, and
  - patients whose medical problems preclude conventional colonoscopy
- Is currently not indicated for the screening of asymptomatic persons
- Can be considered an alternative screening method when patients are unable or unwilling to undergo conventional colonoscopy

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