

CT colonography: implementation and technical developments

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- I. Fisichella V, Hellström M.
Availability, indications, and technical performance of computed tomographic colonography: a national survey.
Acta Radiologica 2006;47(3):231-7
- II. Fisichella VA, Hellström M.
Survey update on implementation, indications and technical performance of CT colonography in Sweden
Acta Radiologica 2009. In press
- III. Fisichella VA, Jäderling F, Horvath S, Stotzer P-O, Kilander A, Hellström M.
Primary 3D analysis with perspective-filet view versus primary 2D analysis: evaluation of lesion detection by inexperienced readers at CT colonography in symptomatic patients
Acta Radiologica 2009;24:1-12
- IV. Fisichella VA, Jäderling F, Horvath S, Stotzer P-O, Kilander A, Båth M, Hellström M. **Computer-aided detection (CAD) as second reader using perspective-filet view at CT colonography: effect on performance of inexperienced readers**
Clinical Radiology 2009. In press
- V. Fisichella VA, Båth M, Johnsson AA, Jäderling F, Bergsten T, Persson U, Mellingen K, Hellström M.
Evaluation of image quality and lesion perception by human readers on 3D CT colonography: comparison of standard and low radiation dose
European Radiology 2009. In press



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CT Colonography: implementation and technical developments

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Background: Computed tomographic colonography (CTC) is a minimally invasive imaging method for the detection of colorectal neoplasms. Uncertainty about its diagnostic performance, optimal visualization method, long learning curve and radiation exposure are among problems with CTC, affecting its implementation in routine health care. Potential means of improvements include novel three-dimensional (3D) CTC displays, such as "Perspective-filet view" (3D Filet), and computer-aided detection (CAD). Increasing awareness of radiation doses in CT promotes low-dose techniques, the effects of which on the prevalence of noise-related artefacts and lesion perception on 3D images are unknown.

Aims: I. To determine the availability and technical performance of CTC in Sweden. II. To compare lesion detection by inexperienced CTC readers using primary 3D Filet analysis versus primary 2D analysis and to evaluate the effect of combined 3D Filet+2D analysis. III. To investigate whether CAD applied to 3D Filet improves the inexperienced reader's performance compared to CAD-unassisted 3D Filet and 2D. IV. To compare the prevalence of noise-related artefacts and lesion perception on 3D Filet at standard and low radiation doses.

Methods: I. Questionnaires on CTC implementation and technical performance were sent to all radiology departments in Sweden in 2005 and in 2009. II. Fifty symptomatic patients were prospectively enrolled and examined with CTC followed by same-day colonoscopy with segmental unblinding. An experienced reader prospectively performed 3D Filet analysis, followed by complete 2D analysis (3D Filet+2D). Two inexperienced readers, blinded to CTC and colonoscopy findings, performed 3D Filet analysis and, after 5 weeks, 2D analysis. True positives ≥ 6 mm detected by the inexperienced readers with 3D Filet and/or 2D were combined to obtain 3D Filet+2D. III. Four months later, the inexperienced readers re-read the cases only evaluating CAD marks on 3D Filet. IV. Forty-eight patients underwent CTC at standard and at low radiation dose. Noise-related artefacts and perception of polyps on 3D Filet images were evaluated at standard dose, original low dose and modified low dose, i.e. after manipulation of opacity on 3D images.

Results: I. In 2009, CTC is performed in 42% of the radiology departments, i.e. 18 additional departments compared to 2005. Attitudes of radiologists are increasingly in favour of CTC. II. For the inexperienced readers, there was no significant difference between 3D Filet and 2D analysis regarding sensitivity and reading time. III. CAD applied as second reader on 3D Filet increased the sensitivity by inexperienced readers, but also the number of false positives, compared to CAD-unassisted 3D Filet and 2D, thus not improving overall performance, i.e. the ability to distinguish between lesions and non-lesions. IV. The mean effective dose was 3.9 ± 1.3 mSv at standard dose and 1.03 ± 0.4 mSv at low dose. Image quality was significantly affected on 3D Filet at low dose compared with standard dose. Reduction of the effective radiation dose to 1 mSv did not significantly impair the perception of lesions ≥ 6 mm.

Conclusions: CTC is increasingly available in Sweden as an alternative to barium enema and complement to colonoscopy. Lesion detection by inexperienced readers does not seem to be influenced by the choice of the display method. It can be improved by the use of CAD. At low-dose CTC corresponding to 1 mSv effective dose, image quality is worsened, but detection of clinically important lesions is not significantly affected.

Keywords: X-ray Computed Tomography; Computed Tomographic Colonography; Computer-Assisted Image Processing; Three-Dimensional Imaging; Colonoscopy; Colon; Rectum; Colorectal neoplasms; Computer-Assisted Diagnosis; Ionizing Radiation.

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