Meta-analysis: computed tomographic colonography

Mulhall B P, Veerappan G R, Jackson J L

CRD summary
This well-conducted review evaluated the test performance of computed tomographic (CT) colonography compared with colonoscopy or surgery, and assessed variables that may affect performance. The authors concluded that CT colonography is specific, particularly for polyps larger than 9 mm, but sensitivity varies. Differences in performance need to be addressed before it can be advocated for generalised screening. The conclusions follow from the evidence presented and can be considered reliable.

Authors' objectives
To determine the test performance of computed tomographic (CT) colonography in comparison with colonoscopy or surgery, and to assess variables that may affect test performance.

Searching
PubMed, EMBASE and the Cochrane Controlled Trials Register were searched from 1975 to February 2005 for articles published in the English language; the search terms were reported.

Study selection
Study designs of evaluations included in the review
Prospective studies in which the results of the index test (CT colonography) were interpreted independently of the findings of the reference standard (colonoscopy or during surgery) were eligible for inclusion.

Specific interventions included in the review
Studies of CT colonography given after a full bowel preparation were eligible for inclusion. The studies had to use at least a single-detector CT scanner, with colon insufflation by air or carbon dioxide, scan intervals no greater than 5 mm, and use both 2- and 3-dimensional views during scan interpretation. The mode of imaging, collimation, reconstruction interval and type of scanner used varied across the included studies. Further details were given in the report.

Reference standard test against which the new test was compared
The studies had to compare CT with colonoscopy or surgery to be included in the review. The reference standards varied across studies and included standard colonoscopy, segmental unblinded colonoscopy, optimised colonoscopy, surgical findings, or the results of double-contrast barium enema. Some studies used a combination of reference standards.

Participants included in the review
Studies of adults undergoing CT colonography were eligible for inclusion. In the included studies, 74% of the participants were at high-risk for colorectal cancer. The participants had a mean age of 61.9 years and 63.6% were male.

Outcomes assessed in the review
Studies that reported data that enabled the calculation of sensitivity and specificity were included in the review.

How were decisions on the relevance of primary studies made?
Two reviewers independently assessed the eligibility of studies for inclusion.

Assessment of study quality
Each study was assessed for several potential sources of bias: disease severity; disease prevalence; prospective design; relevant clinical sample; enrolment of consecutive patients; assurance that all patients underwent reference testing; and
the performance and interpretation of the reference and index tests without knowledge of the preceding results. Two reviewers independently assessed the validity of each included study.

Data extraction
Two reviewers independently abstracted the data from each included study, with any disagreements resolved by consensus. Data were extracted to calculate the sensitivity and specificity per patient, per polyp and for polyps less than 6 mm, between 6 and 9 mm, and greater than 9 mm.

Methods of synthesis
How were the studies combined?
Pooled sensitivities and specificities with 95% confidence intervals (CIs) were calculated for all studies and separately for each polyp size on a per-patient basis, weighted by sample size.

How were differences between studies investigated?
Statistical heterogeneity was assessed using the I-squared and Cochran Q statistics. Threshold effects were assessed using the Spearman statistic and by creating receiver-operating characteristic curves. Stratified analyses and meta-regression techniques were used to explore potential sources of heterogeneity, such as year of publication, imaging technique, collimation width and reconstruction interval, type of scanner and use of a contrast agent.

Results of the review
Thirty-three prospective studies (n=6,393) were included in the review.

Sensitivity of CT.
Overall, the sensitivity for CT colonography was 70% (95% CI: 53, 87). Sensitivity increased as polyp size increased: sensitivity was 48% (95% CI: 25, 70) for polyps smaller than 6 mm, 70% (95% CI: 55, 84) for polyps between 6 and 9 mm, and 85% (95% CI: 79, 91) for polyps larger than 9 mm. There was evidence of statistical heterogeneity for each analysis (P<0.001; I-squared range: 85.2 to 96.7%).

Sources of heterogeneity were width of collimation, type of detector and mode of imaging. Publication year, type of scanner hardware or software, thickness of the reconstruction interval, use of contrast agent and patient characteristics did not impact on the results of the review.

Specificity of CT.
Overall, the specificity for CT colonography was 86% (95% CI: 84, 88). The specificity was 91% (95% CI: 89, 95) for polyps smaller than 6 mm, 93% (95% CI: 91, 95) for polyps between 6 and 9 mm, and 97% (95% CI: 96, 97) for polyps larger than 9 mm. There was evidence of heterogeneity in the overall specificity (I-squared 92.6%; P=0.001), but only moderate heterogeneity was found for each strata of polyp size.

Methodological quality.
The main sources of potential bias were due to differences in disease severity or prevalence across the included studies, the investigators knowing the baseline risk of the participants (clinical review bias), and the use of different reference standards (verification bias).

Authors' conclusions
CT colonography is highly specific, particularly for polyps larger than 9 mm, but the reported sensitivity varied widely. Heterogeneity in the reported sensitivities raises concerns about the consistency of performance and technical variability; this need to be resolved before CT colonography can be used in routine practice.
CRD commentary
The review addressed a clear research question, and the inclusion criteria were detailed and appear appropriate. Several sources were searched for eligible studies, although the restriction to English language articles means that potentially relevant studies might have been missed. Appropriate methods were used to minimise reviewer error and bias in the review process, and adequate details on each of the included studies were presented. Despite the apparent differences across the included studies, the methods applied in the data synthesis were appropriate given the review question. Sources of potential bias and heterogeneity were explored using appropriate methods and were considered in the results and conclusions.

In summary, this was a well-conducted and reported review. The authors’ conclusions were consistent with the evidence presented and are likely to be reliable.

Implications of the review for practice and research
Practice: The authors stated that CT colonography should only be used in research protocols, or when other accepted screening methods are not appropriate, until heterogeneity is more clearly explained and CT colonography is found to be sensitive.

Research: The authors stated that CT colonography needs further refinement before it can be recommended for general use in screening for colorectal cancer.

Bibliographic details

PubMedID
15838071

Original Paper URL
http://www.annals.org/cgi/content/full/142/8/635

Other publications of related interest
This additional published commentary may also be of interest. Bhutani MS, Pasricha PJ. Review: computed tomographic colonography has high specificity but low-to-moderate sensitivity for detecting colorectal polyps. ACP J Club 2005;143:78.

Indexing Status
Subject indexing assigned by NLM

MeSH
Aged; Colon /surgery; Colonic Polyps /pathology /radiography; Colonography, Computed Tomographic /instrumentation /methods /standards; Colonoscopy /standards; Colorectal Neoplasms /pathology /radiography; Female; Humans; Male; Mass Screening /methods; Middle Aged; Sensitivity and Specificity

AccessionNumber
12005008231

Date bibliographic record published
31/01/2006

Date abstract record published
31/01/2006
**Record Status**
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.