The role of carbon dioxide insufflation in colonoscopy: a systematic review and meta-analysis

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CRD summary
This review evaluated the efficacy and safety of carbon dioxide insufflation in patients receiving colonoscopy. The authors concluded that insufflation with carbon dioxide could decrease abdominal discomfort during and following the procedure without any additional adverse reactions. The review findings may not be generalisable to all patient populations. The overall results and the authors' conclusions appear to be reliable.

Authors' objectives
To evaluate the efficacy and safety of carbon dioxide insufflation in patients receiving colonoscopy.

Searching
MEDLINE, EMBASE and The Cochrane Library were searched to December 2010 for published articles in any language. Search terms were reported. Reference lists of included studies were checked for further articles. Abstracts of three conference meetings were searched from 2000 to 2010.

Study selection
Eligible studies were randomised controlled trials of bowel insufflation that compared carbon dioxide with air in patients receiving colonoscopy. The outcomes of interest were abdominal pain and safety of the procedure.

The included trials were carried out in Canada, Norway, USA, China, Austria and Japan. Where reported, the mean age of patients ranged from 48 and 63 years; patients were largely referred to colonoscopy through cancer screening and there were generally more men. The included outcomes were abdominal pain (measured by visual analogue scale) during and after the procedure, flatus after the procedure, complication rate/safety (measured by end-tidal or partial pressure of carbon dioxide), cecal intubation rate and volume of gas used during colonoscopy. Sedation or bowel preparation was carried out prior to colonoscopy in approximately half of the included trials. The carbon dioxide delivery system was reported in all trials. Pre-procedure dietary information and degree of suction during withdrawal of the colonoscope were not reported.

It was unclear how many reviewers applied the inclusion criteria to select trials for the review.

Assessment of study quality
Trial quality was assessed on randomisation method, allocation concealment, double blinding of outcome assessment and use of intention-to-treat analysis. Jadad scores were presented and trials with a score of 4 or more were considered to be high quality.

It was unclear how many reviewers carried out the quality assessment.

Data extraction
Data were extracted to enable presentation of relative risks (RR) and 95% confidence intervals (CI).

Two reviewers independently extracted the data. Discrepancies were resolved by consensus.

Methods of synthesis
Pooled relative risks and 95% CI were calculated in meta-analyses using a random-effects model (where there was statistical heterogeneity) or a fixed-effect model (no statistical heterogeneity). Statistical heterogeneity was assessed using the Cochrane Q test and the I² statistic. Publication bias was assessed with a funnel plot. The number needed to treat (NNT) was calculated. Sensitivity analyses were carried out to show the impact on results of removing one trial, including trials with 100 or more patients and including only trials considered to be high quality.
Results of the review
Nine trials (1,577 patients, range 56 to 349) were included in the review. Four trials scored 4 on the Jadad scale (high quality), four trials scored 3 and one trial scored 2. Five trials reported the randomisation method.

Statistically significant effects were reported in favour of carbon dioxide insufflation over air insufflation in terms of decreased abdominal pain during the procedure (RR 0.77, 95% CI 0.62 to 0.96; seven trials; Ι²=76%; NNT=7) and after colonoscopy at one hour (RR 0.26, 95% CI 0.16 to 0.43; six trials; Ι²=74%; NNT=2), six hours (RR 0.36, 95% CI 0.20 to 0.64; seven trials; Ι²=79%; NNT=6) and 24 hours (RR 0.53, 0.31 to 0.91; six trials; Ι²=49%; NNT=12).

Carbon dioxide insufflation was superior to air insufflation in terms of less passage of flatus at one hour (RR 0.09, 95% CI 0.03 to 0.24; two trials; Ι²=0%) and six hours (RR 0.30, 95% CI 0.14 to 0.62; two trials; Ι²=64%). The result for 24 hours after colonoscopy was not statistically significant.

Cecal intubation rate (four trials) and volume of insufflated gas (two trials) were similar for the carbon dioxide and air insufflation groups. Safety was comparable in terms of end-tidal or partial pressure carbon dioxide (four trials). There were no adverse respiratory complications.

Removal of one trial in sensitivity analysis resulted in a smaller overall effect size for abdominal pain (time period not specified). Other sensitivity analyses did not materially impact the main findings.

No significant publication bias was identified.

Authors' conclusions
Insufflation with carbon dioxide in colonoscopy could decrease abdominal discomfort during and following the procedure without any additional adverse reactions.

CRD commentary
The review question and inclusion criteria were clear and potentially reproducible. Relevant data sources were searched. Attempts were made to minimise publication and language biases. Publication bias was assessed. The review process was not clearly reported for study selection or quality assessment but appropriate steps to minimise error and bias were reported for the data extraction process. Appropriate quality assessment criteria were applied to the included trials but results were reported largely as composite scores with little additional information on individual components. Trials were generally of moderate to good quality.

The trials were combined in suitable meta-analyses. The authors discussed possible reasons for the considerable heterogeneity between trials; this heterogeneity may mean that the results were not generalisable to all patient populations.

The overall results and the authors' conclusions appear to be reliable.

Implications of the review for practice and research
Practice: The authors stated that insufflation with carbon dioxide during colonoscopy warranted widespread clinical use.

Research: The authors did not state any implications for future research.

Funding
Not stated.

Bibliographic details

PubMedID
22271023

DOI
10.1055/s-0031-1291487

**Original Paper URL**

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Abdominal Pain /etiology /prevention & control; Carbon Dioxide; Colonoscopy /adverse effects /methods; Flatulence /etiology /prevention & control; Humans; Insufflation /adverse effects

**AccessionNumber**
12012006713

**Date bibliographic record published**
12/02/2013

**Date abstract record published**
11/07/2013

**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.