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Editorial

Carbon dioxide insufflation in endoscopy - Luxury or need?

Ever since its beginning more than 50 years ago, endoscopy has always undergone constant development and upgrades which have allowed not only more and better diagnoses but also an avoidance of complications and a negative experience for patients on their endoscopy day. The change from fiber endoscopes to video endoscopes, variable rigidity endoscopes, virtual chromoendoscopy (Narrow Band Imaging/NBI, Fujinon Inteligent Chromo Endoscopy/FICE, i-scan) or sedation with propofol are among such advances (1). However, despite all these improvements, the use of certain prolonged tests (ERCP, colonoscopy, etc.) requiring the insufflation of large volumes of air usually result in patient discomfort from colonic distension by retained air after endoscopy (2). This issue is of particular relevance for colonoscopy, a strongly demanded study in clinical practice, most particularly following the implementation of population-based screening programs for colorectal cancer in recent years (2,3).

Gut insufflation (8 liters of gas, whether air or carbon dioxide {CO_2}, on average per colonoscopy) is necessary to "separate" the colonic walls during endoscopy in order to safely advance the endoscope to the desired segment for an adequate assessment of target areas (4). In contrast to other specialized procedures such as laparoscopic surgery, environmental air is usually employed for insufflation during endoscopy, which contributes to render procedures such as colonoscopy more painful for patients because of abdominal distension, which may persist for hours once the procedure is completed (2). As highlighted by the authors of the study reported in this issue of the Journal (5), prolonged air insufflation during endoscopy may cause ischemia from blood flow obstruction (brought about by air pressure on colonic vessels), air embolism, perforation, and intracolonic explosion when an electrocautery is required (6-9). CO_2 is a gas with physical characteristics that make it more soluble in water than environmental air, which is why it is rapidly cleared by respiration as it reaches the alveoli following absorption from the gut lumen into the circulation (2,10-12). In contrast, environmental air usually employed for insufflation during endoscopy is not absorbed and can only be eliminated by belching or passing it through the rectum (2,10-12). Fast CO_2 elimination through respiration will –at least theoretically– facilitate a milder, shorter colonic distension and therefore reduced discomfort following the procedure, thus improving exploration quality and patient experience. However, the fact that CO_2 administration for insufflation and its subsequent absorption into the blood may be associated with increased CO_2 blood levels, which may on occasion bring about metabolic acidosis, must be borne in mind.

While the use of CO_2 in the digestive system represents no real novelty given that reports on this topic date back to 1974 (8,13), interest in the role of CO_2 insufflation for endoscopy and most particularly colonoscopy has been growing in recent

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years (2,10-12,14-16). These studies suggest that pain following colonoscopy might be significantly milder should insufflation result from CO_2 rather than environmental air (2,10-12,14-16). Other authors have suggested that faster CO_2 elimination may reduce the need for sedation, and both exploration and patient recovery time (16).

A meta-analysis has been recently reported which studied evidence on the use of CO_2 *versus* environmental air insufflation as found in the literature (17). The authors carried out a systematic review on this topic and discussed all the available prospective, comparative, randomized, controlled studies. They identified 21 studies: 13 studies on colonoscopy, 4 on ERCP, 2 on double-balloon enteroscopy, 1 on oral endoscopy/submucosal dissection, and 1 on left colonoscopy. The results from this meta-analysis showed that, for colonoscopy, CO_2 insufflation was associated with less pain on procedure completion, and the proportion of patients with pain 1 hour after the examination was smaller in the CO_2 group (RR: 1.84, 95% CI: 1.37-2.47); the same was also true after 6 hours (RR: 1.28; 95% CI: 1.14-1.44). However, the analysis of studies available on the usefulness of CO_2 insufflation for other endoscopic procedures revealed no significant differences, hence the authors suggested that more studies were needed on this subject to allow definitive conclusions.

Experience on this topic is limited in our setting. The study reported by Díez-Redondo et al. (5) in the present issue of *Revista Española de Enfermedades Digestivas* randomized 270 patients referred for colonoscopy with sedation to receive insufflation using environmental air or CO_2, and then compared side effects (desaturation, hypercapnia events…) and patient discomfort. Its findings revealed that patients in the CO_2 group experienced less pain from 15 minutes to 6 hours after test completion, with pain becoming identical at 24 hours. Another Spanish group recently reported in *Revista Española de Enfermedades Digestivas* the results of a study supporting the better tolerability of colonoscopy and combined colonoscopy/gastroscopy when performed using CO_2 rather than environmental air insufflation (18). While this technique has not been widely implemented in our healthcare system, both studies, together with the evidence from the literature, advise that it should be gradually incorporated into clinical practice as a replacement of air insufflation in the next few years.

Other authors have investigated whether the combination of CO_2 insufflation and water immersion may have a synergistic effect in reducing colonoscopy discomfort, and hence allow colonoscopic procedures with minimal sedation (2 mg IV of midazolam) (19). The study, which was carried out in a prospective, randomized way, included 404 subjects and showed that colonoscopy was better tolerated when water immersion rather than gas (air or CO_2) was used applied during entry (97 *vs.* 83.3%, $p < 0.0001$). On the other hand, patients who were administered water at insertion and CO_2 at withdrawal experienced the least discomfort during colonoscopy ($p < 0.05$). At 24 hours after procedure completion patients who received CO_2, had less discomfort when compared to those treated with environmental air regardless of the combination with water immersion during insertion. The results from this study seemingly support the use of water for colonoscope insertion and of CO_2 during its withdrawal to better visualize the colon. Nevertheless, these findings should be confirmed by future studies.

It should be highlighted that, even if we now know considerable facts regarding CO_2 insufflation, important issues on this subject remain unsolved: May CO_2 insufflation reduce perforation risks when examining patients with conditions such as Ogilvie's syndrome, suspected diverticulitis, recent surgery, colon prosthesis placement because of subocclusive disease, etc.? What is the real impact of CO_2 insufflation on

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sedation requirements? Will adherence to screening programs for CRC improve if colonoscopy results in fewer complaints from retained air after the exam? There are no doubt these and other relevant concerns on this topic will be solved in the near future, thus helping us improve quality in patient care.

In summary, evidence available in the current literature is enough to support the use of CO_2 for insufflation during colonoscopy, as this is a safe technique that allows to reduce discomfort resulting from colon distension during endoscopy and in the few hours after the procedure. This is why we believe it necessary to make every effort to modernize our present clinical practice in order to incorporate these tools into endoscopy units within our healthcare system.

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