



Factors Affecting Pre-Endoscopic Bowel Preparation

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Abstract

Bowel preparation for colonoscopy was designed as a means to improve the diagnostic and therapeutic accuracy and safety of the procedure. Adequate bowel preparation is important for a successful colonoscopy. The effectiveness of colonoscopy may be limited by the particular circumstances of a person's health such as age, pregnancy and comorbidities or even mental state that impede the ability to comply with the instructions for preparation of the bowel. Therefore, it is necessary for the endoscopic healthcare team to identify the specific conditions of the patient and to choose the suitable laxative agent. The purpose of this review is to explore the most efficient and safest bowel preparation for colonoscopy in individuals with underlying diseases, to reduce the frequency of inadequate preparation, adverse side effects, mis-diagnoses and suffering of the patient from the need to repeat the examination. For patients with diarrhea, renal failure, hepatic failure, heart problems, dehydration, bleeding, inflammatory bowel diseases, taking antihypertensive medications or are pregnant is safe and effective the use of polyethylenoglycol (PEG). For patients with diabetes, PEG with magnesium citrate or sodium phosphate (NaP) is recommended and for patients with constipation NaP or mosapride. Also, for the elderly before the administration of any laxative, biochemical tests should be done. PEG is the gold standard bowel preparation in patients with underlying diseases. Administration of NaP should be done with caution taking into account its absolute contraindications. The bowel preparations have not been adequately studied in special populations, while there is a need to develop new and more efficient preparation drugs with improved tolerability and reduced side-effects. The selection of a laxative agent should be tailored to each individual, taking into account the underlying disease and patient preference.

Keywords: Bowel Preparation, Colonoscopy, Diabetes, Constipation, Diarrhea, Renal Failure, Hepatic Failure, Electrolyte Disorders, Medication, Bleeding, Elderly, Cardiac Problems, Dehydration

INTRODUCTION

Bowel preparation is essential prior to surgery to minimize the risk of fecal contamination as well as prior to endoscopic or radiological assessment of the large and small bowel to maximize overview or imaging, respectively [1]. Especially for endoscopy, good bowel preparation is important to achieve optimal visualization of the mucosa and therefore accurate diagnosis and safe treatment [2,3]. The degree of bowel cleansing is the factor that determines the quality, speed and difficulty of completing the endoscopy [4].

Pre-endoscopic bowel preparation is a complex process, including dietary modifications and the use of a laxative according to the patient's needs [5]. The ideal laxative should remove all solid and liquid components from the colon, not be harmful to the intestinal mucosa, be easily administered, be tolerated by the patient without side effects, and cause minimal electrolyte disturbances [2]. Unfortunately, none of the available preparation regimens respond in all these requirements [3].

Colon cleansing products can be classified into three groups: i. Isosmotic solutions of polyethylenoglycol (PEG) which act as enema solutions, ii. Hyperosmotic agents (sodium

phosphate (NaP), magnesium citrate, lactulose, mannitol) which draw extracellular fluid through the intestinal wall into the lumen, iii. Stimulants (castor oil, senna, sodium picosulfate, bisacodyl) which increase smooth muscle activity within the gut wall. The choice is usually between whether to use polyethylene glycol or some osmotic agent [6].

Inadequate bowel preparation is reported in 20-40% of patients undergoing colonoscopy [7]. This is partly due to the fact that endoscopy centers usually prescribe the same laxative regardless of the patient's particular characteristics [8]. In 2009 the National Organization for Patient Safety (NPSA) issued a warning, based on 218 cases of problems immediately following the use of oral laxatives and concerns about their administration [9]. The choice of laxative requires consideration of the indication for endoscopy and the recipient's underlying diseases, based on the advantages and disadvantages (eg, tolerability, safety, efficacy, potential side effects) of the various bowel preparation regimens. Therefore, the clinical assessment of each patient to identify contraindications and risks in the administration of specific laxatives, as well as their written and oral information on their safe intake, must be done by a healthcare professional. Taking a detailed clinical history (medications, comorbidities

such as liver, kidney, heart failure) as well as laboratory testing (electrolytes, creatinine clearance) in patients prone to complications contribute in this direction [1].

There is a small number of clinical trials on the choice and safety of bowel laxatives in patients with underlying diseases or with special characteristics. The aim of this review is to investigate the most effective but also the safest bowel preparation in people with underlying diseases, so as to reduce the frequency of insufficient preparation, unwanted side effects, wrong diagnoses and patient suffering from the need to repeat the examination.

METHODS

A literature search was conducted in the electronic databases Medline/Pubmed, Scopus, with the use of the following keywords : "Bowel Preparation", "Colonoscopy", "Diabetes", "Constipation", "Diarrhea", "Renal Failure", "Hepatic failure", "Electrolyte disorders", "Medication", "Pregnancy", "Bleeding", "Elderly", "Cardiac problems", "Dehydration", "Obesity", "Inflammatory bowel disease". The keywords were used in each database in combination, for example each underlying disease with bowel preparation and colonoscopy.

RESULTS

Diabetes Mellitus

It is known that patients with diabetes mellitus (DM) present more often than the general population nausea, vomiting, dysphagia, diarrhea, constipation due to slow gastric emptying. The need for colonoscopy is very common in patients DM due to the predominance of gastrointestinal symptoms, while studies have shown a relationship between diabetes mellitus and colon cancer [10].

It appears that polyethyleneglycol (PEG) is not sufficient as bowel preparation for colonoscopy in diabetic patients [11-13]. There is difficulty of these patients in consuming large amounts of liquids because a feeling of satiety is created due to slow gastric emptying. In diabetic patients the solution of PEG in combination with magnesium citrate had good efficacy, tolerance and acceptance by patients [10]. Studies by Ozturk et al [14,15], showed that NaP achieves good bowel preparation in patients with DM without causing electrolyte disturbances or affecting blood sugar and creatinine. In the study by Khurana et al [16], elderly patients with DM had a decrease in glomerular filtration rate during a follow-up time after NaP intake, while two cases of acute renal failure in diabetic patients receiving NaP are reported and should therefore be avoided due to the risk of hyperphosphatemia and metabolic oxidation. Another factor to consider is the duration, regulation of sugar levels and the presence of complications from DM, which can affect the effectiveness of the laxative, such as diabetic neuropathy [17].

Constipation

One of the most difficult but frequent problems associated with the patient and the prognosis for insufficient bowel

preparation is constipation. Constipated patients have slower bowel transit and are less receptive to bowel preparation [18].

The bowel preparations with 3 sachets of sodium picosulfate and bisacodyl are not sufficient for patients with constipation [19] neither were the combination of 15mg mosapride citrate and 2 liters PEG [20]. Factors such as the dose and timing of laxatives should be modified since mosapride has been found to be effective in constipation due to Parkinson's or Irritable Bowel Syndrome. The use of mosapride for the preparation of patients suffering from chronic constipation is superior to PEG with no difference in side effects [20].

In the study by Lee et al, it is found that the use of probiotics two weeks before the colonoscopy in combination with NaP had good results in patients with constipation. However, the cost of probiotics and their effectiveness were not considered. Further studies need to be done to explain how probiotics affect the bacterial intestinal flora resulting in the reduction of gastrointestinal symptoms such as bloating from the preparation. The effectiveness of other probiotic strains can still be studied [18].

The studies by Chen et al [22, 23], showed that NaP is more effective in patients with constipation than bisacodyl and PEG. The large volume of fluids that patients, who already have abdominal distention due to constipation, must take in reduces their compliance with PEG and therefore its effectiveness.

Diarrhea

The lack of studies in patients with diarrhea regarding the proposed bowel preparation has led to indirect conclusions from studies that the use of the laxative led to diarrhea or that the laxative creates a problem in the differential diagnosis of the cause of the diarrhea. As seen from the study by Zwas et al [24], in patients with unclear chronic diarrhea or suspected IBD disease it is recommended to avoid the use of sodium phosphate as a bowel preparation due to the risk of misdiagnosis. Fincher et al [25], found that bisacodyl causes diarrhea without affecting patient satisfaction with the preparation. Finally, in the study by Beloosesky et al [26], the electrolyte disorders (hypocalcemia, hypokalemia) caused in 36 elderly hospitalized patients, with episodes of severe diarrhea, after the administration of sodium phosphate prevented its use in people who already suffer from diarrhea.

Renal failure

Results from studies on the safety of NaP administration are inconsistent and conflicting. Discrepancies appeared in the studies regarding the risk of renal damage after NaP administration. These are, due to the different populations in terms of age, gender, pre-existing kidney disease, but also to the inability to record data regarding hydration management during NaP intake [27,28].

Elderly and dehydrated patients are more prone to develop electrolyte and metabolic disorders after bowel preparation. Especially the elderly may suffer from an undiagnosed incipient renal failure and phosphorus intake helps in its manifestation. At the same time, the inability to control the amount of water taken in, since the preparation is done at home, worsens the problem of dehydration. Renal function should therefore be assessed in patients who are to receive NaP as a preparation and their ability to comply with the intake of the required amount of fluids. In general, its use should be avoided in patients with diagnosed renal failure of any degree. But the great effectiveness of NaP in the quality of bowel cleansing and in the detection of lesions in the intestinal lumen favors its use [29].

Liver Failure

Also, the lack of studies addressing bowel preparation in patients with liver failure has led to drawing conclusions indirectly from the electrolyte disturbances that laxative administration can create in healthy patients and consequently in cirrhotics. In the study by Pelham et al [30] it appears that the administration of the solution (960 mL) of sulfates is safe for patients with moderate liver disease. Administration of NaP seemed insufficient but also causes sodium and phosphorus retention, while PEG is not sufficient in some cases of cirrhosis [29]. Then, it appeared that patients with cirrhosis need more intensive preparation or dieting for a longer period of time [31].

Cardiac Problems

Studies that assess the effects of laxatives in patients with cardiac problems are scarce. There is research that demonstrates that the use of the widely known laxatives PEG and NaP carry the same risks for arrhythmias. The electrolytic changes from the use of NaP increase the risk of cardiac problems, but also the intake of PEG even in a limited volume can cause fluid retention. Therefore, PEG in divided doses or low volume and under monitoring, is a safer solution for cardiac patients who should be aware of the appearance of any symptoms (tightness in the chest, shortness of breath). However, further studies are needed with other laxatives in this group of patients [32,33].

Use of Medicines

Studies demonstrate the relationship between specific drugs such as ACE inhibitors, NSAIDs and diuretics, NaP intake and reduction of glomerular filtration rate and in some cases the occurrence of acute renal failure. Avoidance of these drugs and adequate hydration reduce the risk of increased phosphate load from NaP administration [31,34].

Pregnancy

The need for colonoscopy during pregnancy is rare and should only be done in life-threatening bleeding or to avoid surgery. The safety and efficacy of screening in these

individuals has been poorly studied. Colonoscopies are safe in pregnant women both for themselves and for the fetus [35]. When a sigmoidoscopy is to be performed it is safe to use tap water enemas. PEG, when used in low doses in postpartum constipation, it is safe. It also causes less bloating and gas compared to other laxatives. The use of preparations containing phosphorus should be avoided due to the electrolytic disturbances that they may cause and the failure of bone growth in newborns whose mothers had a high phosphorus load [36,37].

Bleeding

Adequate bowel preparation prior to emergency colonoscopy to treat hematochezia can lead to successful identification of the source of bleeding and contribute to hemostasis. However, the management of acute intestinal bleeding is not defined and depends on the preferences and experience of the endoscopist. Some researchers report high rates of diagnosis without bowel preparation because the blood acts as a laxative, others that only enemas are needed to cleanse the rectum, and there are some who find high success rates with the use of oral laxatives [38,39].

Researchers who question the use of laxatives argue that they erase the signs of recent bleeding, preventing the detection of the actual damage, making therapeutic intervention impossible and reducing the diagnostic accuracy of the test. But also the use of enemas has the limitation of displacement of blood to areas closer to the bleeding area, leading to incorrect interpretations. In contrast, proponents of laxatives believe that it is impossible to detect small or superficial lesions such as vasculature in an unprepared bowel [40]. The administration of PEG as a bowel preparation before emergency colonoscopy in patients with hematochezia had better results than enemas in terms of diagnostic frequency, completion of the examination, and need for repetition. Contrary to the bleeding after polypectomy or when the point of bleeding can be safely calculated, the colonoscopy is performed with an enema or no preparation at all [38].

Elderly

The percentage of the elderly population is constantly increasing and the need for safe diagnostic and therapeutic methods to explore pathologies becomes imperative. The elderly are more likely to need a diagnostic evaluation of the colon, but they also have the greatest risk of morbidity during the endoscopy. A significant loss of fluids in the human body due to the use of laxatives can lead to various adverse reactions, which the elderly are more prone to experience due to the reduction of compensatory mechanisms, especially of the heart, kidneys and cerebral vessels [41].

In the study by Yao et al [42], the administration of 500 mL of enteral feeding improved the safety of bowel preparation by reducing the side effects of laxatives (hypoglycemia, hypovolemia, chest tightness) without affecting the quality

of bowel preparation. Also the use of magnesium sulfate had more side effects than PEG. The tolerance of the elderly to the intake of PEG or NaP or even picosulfate differs. If compared with younger patients they show similar or even better tolerance to the preparation. However, the quality of bowel preparation was poorer than in the young if given PEG, sodium picosulfate and similar when NaP was given [41].

Indeed, special care is needed in the choice of laxative for this age group, taking into account all the symptoms that might exclude the use of some laxatives, but also by measuring electrolytes and glomerular filtration rate in people prone to serious side effects. The high rate of poor preparation in the elderly (about one in five), but also the frequent obstructive pathology of the bowel that prevents completion of the examination, should be weighed against the advantages of an axial colonoscopy [43].

Inflammatory Bowel Diseases

Colonoscopy is a diagnostic and cancer screening tool in patients with Inflammatory Bowel Diseases (IBD). Bowel preparations have been identified as causative agents of toxic megacolon. After the 1980s, there is a clinical consensus to avoid bowel preparation in patients with severe ulcerative colitis and if necessary to perform flexible sigmoidoscopy without preparation. Also, patients with ulcerative colitis have increased mucosal permeability and are more sensitive to residual glutathione from endoscopic decontamination that causes colitis symptoms [44].

In patients with suspected IBD, NaP (oral or enema), bisacodyl (enema), and sodium picosulfate with magnesium citrate should be avoided because they create signs of non-specific colitis. The use of PEG in patients with IBD is safe, while the addition of simethicone reduces the symptoms of abdominal distension [45]. For patients with moderately active colitis, bowel preparation is not necessary, due to the expulsion of the contents from the inflamed segments and thus the areas of interest are always clear [46].

CONCLUSIONS

In patients with DM preparation with polyethylenoglycol (PEG) is not sufficient. The combination of PEG with magnesium citrate seems to be effective, as well as NaP, which should be administered with caution in the elderly, taking into account the glomerular filtration rate. Other factors that should be considered in these patients are the duration of the disease, the regulation of glucose levels, and the presence of complications from the disease, so that preparation is enhanced.

In patients with constipation, NaP is more effective, while the use of probiotics two weeks earlier seems to be beneficial. Mosapride seems to be the laxative agent that will replace or be used in combination with the known ones, but further research is needed. On the other, in patients with diarrhea, the use of NaP should be avoided because there is a risk of

misdiagnosis due to the creation of aphthous lesions and also due to the strengthening of electrolyte disorders in an already burdened organism. Bisacodyl and magnesium citrate should also be avoided. There are no studies demonstrating the safety of administering another laxative, but polyethylenoglycol may be safer due to its isosmotic effect.

Then, in patients with renal failure of any degree, administration of NaP should be avoided, while PEG is considered safe. Also, the sulfate solution may be the future low-volume alternative laxative, but requires more studies on the safety and effectiveness of its administration in patients with renal failure. In patients with liver failure NaP should be avoided, PEG is safe but its use may not be effective so it should be combined with other laxatives or a longer diet. For the new sulfate solution, its effectiveness in patients with liver disease has not been investigated. Also, NaP should be avoided in patients with electrolyte disturbances. PEG is safe to use in young patients, but electrolytes should be checked first in the elderly. In elderly patients the administration of NaP, magnesium sulfate, picosulfate and polyethylenoglycol, should be done with caution and after obtaining biochemical tests. NaP should also be avoided in patients taking ACE inhibitors, ACE inhibitors, NSAIDs and diuretics because they decrease the glomerular filtration rate and increase the risk of acute renal failure.

The use of PEG, as bowel preparation, is effective in emergency colonoscopy in patients with hematochezia. But also emergency colonoscopy with enema only, when there is no time for preparation, facilitates the localization of the bleeding site and endoscopic hemostasis in severe hematochezia or when the hemorrhagic focus can be assumed. The decision on the method of bowel preparation should be based on the clinician's experience and expertise.

In patients with cardiac problems, NaP should be avoided because of the risk of electrolytic disorders. The administration of PEG, in divided doses or in low volume and under monitoring, is a safer solution, however, should be cautious to the appearance of any symptoms of intolerance (tightness in the chest, shortness of breath). Finally, in patients with IBD, PEG is safe to use. In patients with suspected IBD, NaP (oral or enema), bisacodyl (enema), and sodium picosulfate with magnesium citrate should be avoided because they create signs of non-specific colitis. In patients with mild-moderate ulcerative colitis, colonoscopy can be performed without preparation, while in severe active ulcerative colitis, colonoscopy is avoided due to the risk of toxic megacolon, and if necessary, flexible sigmoidoscopy is performed without preparation.

At the end, patient education regarding bowel preparation instructions is important to ensure adequate preparation and reduce its side effects. They must understand the need for their cooperation and compliance to optimize safety,

of damage and the need to repeat the examination. The physician and nurse plays an active role in the process. Clear written instructions should be provided, and some professionals use videos or computer training programs to make them easier to understand. Careful discussion of the entire process can alleviate fears and resolve questions. A phone call to the patient before the procedure is usually appreciated and enhances compliance [47].

It is necessary for the endoscopic health team to identify the specific conditions of the patient in order to select the appropriate laxative method in order to maximize the effectiveness and safety of both the preparation process and the subsequent colonoscopy. Bowel preparations have not been adequately studied in specific populations and randomized clinical trials are needed. There is also a need to develop new regimens with greater efficacy, improved tolerability and fewer side effects.

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Citation: Efstathia Ragkousi, Ioanna Tsatsou, Anastasia Gyftea, Aggeliki Mavrommati, "Factors Affecting Pre-Endoscopic Bowel Preparation", *Universal Library of Clinical Nursing*, 2024; 1(1): 29-35. DOI: <https://doi.org/10.70315/uloap.ulcnu.2024.0101004>.

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