

# We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

186,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index  
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?  
Contact [book.department@intechopen.com](mailto:book.department@intechopen.com)

Numbers displayed above are based on latest data collected.  
For more information visit [www.intechopen.com](http://www.intechopen.com)



## Optimal Bowel Preparation for Colonoscopy

Sansrita Nepal<sup>1</sup>, Ashish Atreja<sup>2</sup> and Bret A Lashner<sup>2</sup>

<sup>1</sup>Medicine Institute, Cleveland Clinic

<sup>2</sup>Digestive Diseases Institute, Cleveland Clinic  
USA

### 1. Introduction

Colorectal cancer is the third most cancer in the US and the second most cause of cancer deaths. The general lifetime risk of developing cancer in the United States is about 6%. Colorectal cancer almost always develops from precancerous polyps (abnormal growths) in the colon or rectum. There are various screening tests available for the colon cancer. High sensitivity FOBT, flexible sigmoidoscopy and colonoscopy are the most commonly used ones. Flexible sigmoidoscopy only checks for polyps or cancer inside the rectum and lower third of the colon, while colonoscopy also checks for colon polyps or cancer inside the rectum and the entire colon. It is also used as a follow-up test if anything unusual is found during one of the other screening tests. Other screening tests being studied are virtual colonoscopy and stool DNA test- though currently these are not covered uniformly by the insurance companies.

Colonoscopy is a very important screening test that is thought to be playing a pivotal role in the decline of the colorectal cancer rates in the developed countries by facilitating the early detection and the removal of the adenomatous polyps. Guidelines from national societies recommend routine screening for colorectal cancer starting the age of 50 years in patients at average risk. Adequate bowel preparation is important in assuring the quality and accuracy of the colonoscopy (see figure 1). However, preparing for a colonoscopy can be frustrating for the patients. It is the role of the care providers to take time to explain to the patients how exactly they should approach in order to avoid any failures and repeat exams which can be agonizing for the patient. Regardless of the preparation selected, the potential financial burden of a repeat colonoscopy and preparation can be huge. Specifically, the patient may be required to pay additional co-pay for each examination and the financial intermediary may deem repeat examinations unnecessary. In these instances, the patient may be responsible for payment in full for repeat examination incurred due to inadequate bowel preparation.<sup>1</sup> This can be prevented by handing out patient instruction sheet along with the bowel preparation that can be used as a step by step guide before the colonoscopy. Patients should be motivated to ask questions or call doctor's office if they have any trouble or do not understand the patient instructions.

The most important factor affecting the quality of colonoscopy results is the extent of bowel cleansing. Patient tolerance of his/her colonoscopy bowel preparation- regimen affects

patient compliance and henceforth his willingness to undergo repeated examinations. Patient compliance becomes a pivotal factor as it has been shown that inadequate bowel preparation reduces the quality of colonoscopy. This in turn leads to increased procedural risks and hinders the better visualization of the colonic mucosa increasing missed polyp detection rates<sup>2,3</sup>. There are myriad of the bowel preparation agents available in the market which can make the right choice difficult. The next section describes in detail the commonly used bowel preparation agents and measures that can enhance patient compliance and acceptability of the bowel regimen prescribed to them.

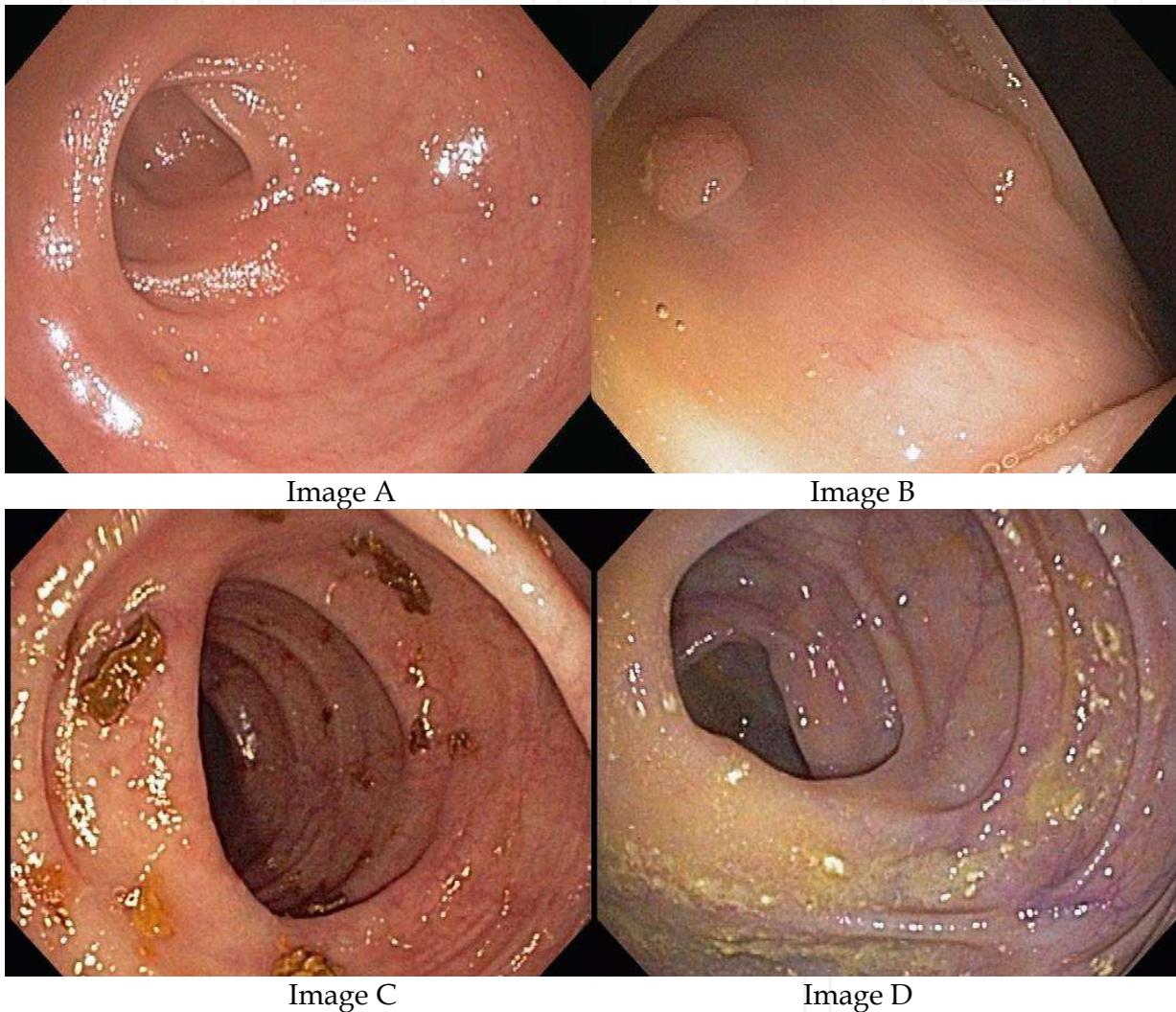


Fig. 1. Displays the images of colon with adequate and inadequate bowel preparation. Bowel preparation is excellent in images A and B allowing optimal visualization of a polyp in image B. In contrast, Images C and D have inadequate bowel preparation with solid or semisolid debris that partially obscures view of the mucosa. (copyright permission taken from Cleveland Clinic)

### 2.1 Choosing the right bowel preparation agent

In general, the bowel preparation agents can be classified into one of three categories:

- Polyethylene glycol (PEG) solutions, which work as high-volume gut lavage solutions

- Osmotic agents (sodium phosphate, magnesium citrate, etc.) which draw extracellular fluid across the bowel wall and into the lumen
- Stimulants (castor oil, senna, sodium picosulfate, and bisacodyl), which work by increasing smooth muscle activity within the wall of the colon.

In current conditions, often the decision rests between using PEG or one of the osmotic agents. Stimulants are now mainly used as adjuncts to bowel preparation. Details about each agent and their pros and cons are specified below:

### 2.1.1 Polyethylene glycol

PEG solutions are the most commonly used bowel preparation options. They are non-absorbable and thus pass through the bowel without any net absorption and thus do not induce any substantial shifts in fluid and electrolyte levels.

Most of the commercially available PEG Preparations can be classified into the following three groups –

#### Standard PEG solution

Traditionally, 4 L PEG solution (CoLyte, GoLYTELY) are given the night before the colonoscopy. These are inexpensive and covered by the insurance companies. The main disadvantage is the poor palatability and large volume which causes compliance issues with 5-15% of the patients.<sup>4,5</sup> Large volumes are required to achieve a cleansing effect, and since this can be difficult to tolerate, nowadays split-dosing is recommended to enhance patient compliance (see patient instructions for details on split-dose standard PEG solutions).

#### Flavored PEG solutions

In order to decrease the salty-taste and “rotten-egg” smell from standard sulfate containing PEG solutions, attempts have been made to make sulfate free PEG solutions (SF-PEG). SF-PEG solutions in US are available in various flavors (NuLyte and TriLyte). The patient tolerance is better and it is as effective as PEG in terms of effective colonic cleansing.<sup>6</sup>

#### Low volume PEG solutions

Drinking large volume like 4 L is one of the main issues with the standard PEG solutions. Hence, several efforts have been made to reduce the volume related side effects like bloating (see section below-making bowel preparation more tolerable). Low-volume polyethylene glycol preparations such as HalfLyte and MoviPrep were developed to improve patient tolerance by reducing the amount of solution required, while maintaining efficacy by adding bisacodyl or ascorbic acid.<sup>7-10</sup>

#### Advantages of PEG solutions

- Standard PEG solutions are affordable and covered by most insurance
- Safe in patients with the electrolyte disorders
- Safe in advanced liver disease
- Can be administered safely in poorly compensated congestive heart failure or renal failure (under supervision)

#### Disadvantages

- Large amount of solution 4L required to achieve a cathartic effect and this affects the patient compliance terribly

- Poor salty taste in standard sulfate containing solutions affecting compliance
- Contraindicated in patients with allergies to PEG compounds, gastric outlet obstruction, high grade small bowel obstruction, significant colon obstruction, perforation, diverticulitis and hemodynamic instability
- Rarely are they associated with Mallory Weiss tear, toxic colitis, pulmonary aspiration, hypothermia, cardiac arrhythmias, and pancreatitis, SIADH <sup>11,12</sup>

### 2.1.2 Making bowel preparation more tolerable

As mentioned in previous section, drinking large volume like 4 L is one of the main issues with the PEG solutions. Several efforts have been made towards reducing the volume related side effects like bloating and hence trying to increase the patient compliance (see table 1 for list of measures that are recommended to enhance patient acceptability of PEG solutions)

There are many studies that have compared the efficacy compared to the traditional large volume PEG solutions. One such study compared full volume 4L PEG with low volume 2L PEG combined with magnesium citrate have demonstrated equal efficacy of colon cleansing but with improved overall patient tolerance.<sup>13</sup> Preparation like HalfLyte uses 2 L of PEG solution in combination of bisacodyl in an attempt to achieve similar efficacy.<sup>14</sup> Low-volume polyethylene glycol preparations such as HalfLyte and MiraLax were developed to improve patient tolerance by reducing the amount of solution required, while still maintaining efficacy by adding bisacodyl or magnesium citrate. Studies in the past had shown 2-L solutions to be as effective as 4-L solutions in terms of colon cleansing, and to be better tolerated. <sup>13-15</sup> though some believe that 4 L PEG treatment is sometimes better than 36 mg senna and 2 L PEG because of fewer failures.

Studies have also compared low-volume PEG + ascorbic acid with the full dose PEG and concluded that the low volume had comparable efficacy as high-volume PEG solution but had superior palatability<sup>16</sup> However it was noted that the cleansing results were worse if patients received the full dose PEG + Ascorbic acid the evening before the procedure compared to the split dose. The data supported the administration of PEG + Ascorbic acid as a split dose before the procedure.<sup>17</sup>

Studies have also compared conventional volume (4 L) of PEG-ELS with those of a low volume (2 L) in combination with pretreatment using different laxatives, such as magnesium hydroxide (milk of magnesia) and olive oil. Addition of Olive oil was found to be superior in these studies.<sup>18</sup>

Another approach in increasing patient compliance by making these bowel preparation more palatable are adding flavors : PEG-electrolyte solutions are available in multiple flavors such as cherry, citrus-berry, lemon-lime, orange, and pineapple. Gatorade, Crystal Lite, and carbohydrate-electrolyte solutions have been used to improve palatability in both PEG and NaP solutions.

Combining over-the-counter (OTC) PEG-3350 laxative powder (MiraLAX) and Gatorade or Crystal Light (or other clear liquid of choice) has also been shown to improve the taste and tolerability of the preparation. MiraLAX is gaining acceptance as a bowel cleanser for colonoscopy Although beneficial and common in certain regions of the US, combining OTC PEG laxative powder with clear fluids is not an official FDA approved preparation for bowel preparation and its use is considered off-label. Studies have shown the quality of split

dose Miralax bowel preparation is inferior compared to the 4L split dose Golytely for screening colonoscopies.<sup>19,20</sup>

Options	Comments
Using split-bowel preparation	Enhances acceptability as well as efficacy of bowel preparation. Should be standard of care for all afternoon colonoscopies and, if practical, for morning colonoscopies
Utilizing low volume or sulfate free solution	May enhance acceptability but at an added cost to patient
Chilling the solution	Enhances acceptability without impacting cost or efficacy
Adding lemon slices or sugar-free flavor enhancers (such as Crystal Light) or lemon juice	Enhances acceptability without impacting cost or efficacy. Flavors should not be red colored.
Adding metoclopramide (5 to 10 mg) orally to prevent or treat nausea	Metaclopramide can be substituted with other anti-nausea medications. Use of anti-nausea medications is optional
Adding magnesium citrate (1 bottle, about 300 mL) in patients without renal insufficiency, or bisacodyl (two to four tablets of 5 mg each), so that the volume can be less <sup>15,16</sup>	Some commercially prepared agents come prepackaged with bisacodyl or senna tablets. Shown to have equivalent efficacy as standard 4 L PEG solutions.
Stopping further ingestion of solution once the stool is watery and clear on the morning of the procedure (for patients who can clearly understand and follow bowel preparation instructions)	Shown to be beneficial in some studies. Still not widely practiced.
Giving the solution by nasogastric tube (at a rate of 1.2-1.8 L per hour) in patients with swallowing dysfunction or altered mental status	Especially relevant for hospitalized patients who have easy access to personnel to place nasogastric tube.

Table 1. Measures that can increase patient acceptability of peg solutions

The recently updated guidelines on colorectal cancer screening by the American College of Gastroenterology recommend the best practice of “split-dosing” for both PEG and sodium phosphate preparations. This is based on the data from numerous studies that have shown that split-dosing of bowel preparations (i.e., administering the first half of an agent the night before and the second half the day of colonoscopy) achieves better results than administering a single dose the day before the procedure. When all of the bowel preparation is given on the day before examination, the interval between the last dose of preparation and the performance of colonoscopy is prolonged, the probability of poor preparation increases dramatically, particularly in the cecum and ascending colon. Splitting decreases the time between the end of bowel preparation and the start of colonoscopy leading to improved efficacy. In addition, improve tolerability results from the fact that patients have to take only half the dose at a given

time. Many institutions, including ours, now routinely advise split regimens for all afternoon colonoscopies. However, for morning colonoscopies, especially when patients have to travel long distances on day of colonoscopies, splitting may have some practical limitations. Since patients are advised not to drink or eat at least 2 hours before colonoscopy to prevent the risk of aspiration during sedation, patients may have to get up early AM (some time between 3 and 5 AM) to take second half of split dosing and still may have to evacuate bowel many times during travel.<sup>21-25</sup>

### 2.1.3 Sodium phosphate (NaP)

Sodium phosphate is commonly used for bowel cleansing before colonoscopy. It is an osmotic laxative that draws water into the bowel lumen to promote colonic cleansing. Retention of water in the lumen of the colon stimulates peristalsis and bowel movements. In December 2008, the FDA issued a black boxed warning for prescription oral sodium phosphate about the potential for acute phosphate nephropathy. Despite the boxed warning, studies suggest that oral sodium phosphate is a safe choice in properly screened patients.<sup>26</sup> A 2007 cohort study of 7,897 patients with normal renal function compared oral sodium phosphate and polyethylene glycol before colonoscopy. The risk of renal dysfunction was the same in both groups<sup>27</sup>

#### Advantages

- Affordable
- More tolerable to the patient
- No need for the ingestion of large volumes such as in PEG

#### Disadvantage

- Case reports linking NaP bowel preparation products to acute and chronic renal insufficiency were published in 2002<sup>28</sup>
- Renal failure due to hyperphosphatemia (acute phosphate nephropathy) has also been reported in patients with normal kidney function.<sup>29</sup>
- Studies have shown that older patients have a decrease in glomerular filtration rate for six months after oral sodium phosphate intake in older patients with normal baseline creatinine levels.<sup>30</sup>

Risk factors that increase the potential for NaP related side effects include:

- chronic kidney disease,
- bowel obstruction, and
- active colitis.
- medications (e.g., diuretics, ACE inhibitors, angiotensin receptor blockers, nonsteroidal anti-inflammatory drugs)
- hypovolemia

#### Commercially available NaP products

Though no longer available over the counter, NaP can still be prescribed by the physicians. Visicol and Osmoprep are the two tablets forms available. NaP-based bowel preparations are easy, quick, and safe to use. Many people prefer these products because of that fact that it is a pill preparation. This gives patients the choice of what clear fluids to take it with. In clinical trials, 95% of people who took OsmoPrep said they would choose it again.<sup>31</sup>

However the drawback is the large amount of the tablets that need to be consumed. Visicol is a bowel purgative that contains microcrystalline cellulose (MCC) residue that impairs full visibility during a colonoscopy. Colonoscopic visualization is decreased by MCC when NaP is used alone but is improved by the addition of laxatives on the previous day.<sup>31</sup> Split dosing with MCC Residue Free -NaP (RF-NaP, OsmoPrep) was associated with high overall Colon Cleansing and achieved response rates of 90%, 97%, and 100% for 28, 32, and 40 tablets, respectively, compared with 86% for Visicol. In addition, RF-NaP evening-only regimen response rates were 90% (32 tablets) and 72% (28 tablets). Transient shifts in electrolyte levels were reduced, and GI adverse events were less common with lower RF-NaP dose regimens.<sup>32</sup>

There have been many randomized controlled trials (RCTs) comparing polyethylene glycol (PEG) with sodium phosphate (NaP). Meta-analysis comparing RCTs published between 1990 and 2008 comparing 4-L PEG with two 45 mL doses of NaP in adults undergoing elective colonoscopy showed that NaP was more likely to be completed and to result in an excellent or good quality preparation.<sup>33</sup> A split-dose regimen that administered the first dose of sodium phosphate on the previous evening and a second dose on the morning of the procedure (10-12 hours apart) was significantly more effective than PEG-based regimens for colorectal cleansing in preparation for colonoscopy, sigmoidoscopy or colorectal surgery. A regimen that administered both doses of oral sodium phosphate on the day prior to the procedure offered no colorectal cleansing advantage over PEG-based regimens and was significantly less effective than the split-dose NaP administration (i.e. regimen that administered one dose on the previous evening and a second dose on the morning of the procedure). Also, it has been shown that three doses (administered 10 minutes apart) of 15 mL of oral sodium phosphate solution, each diluted in 250 mL of clear fluid was associated with less vomiting than one 45 mL dose of the solution diluted in 250 mL of clear fluid.<sup>34</sup>

#### **2.1.4 Magnesium citrate and oral sodium picosulfate**

Oral sodium picosulfate + magnesium citrate, consisting of sodium picosulfate (a stimulant laxative) and magnesium citrate (an osmotic laxative), is approved for use in adults (CitraFleet; Picolax) and/or adolescents and children (Picolax) in Europe and Australia as a colorectal cleansing agent prior to any diagnostic procedure (e.g. colonoscopy or x-ray examination) requiring a clean bowel and/or surgery. It is dispensed in powder form (sodium picosulfate 0.01 g, magnesium oxide 3.5 g, citric acid 12.0 g per sachet), with the magnesium oxide and citric acid components forming magnesium citrate when the powder is dissolved in water. It acts locally in the colon as both a stimulant laxative, by increasing the frequency and the force of peristalsis (sodium picosulfate component), and as an osmotic laxative, by retaining fluids in the colon (magnesium citrate component), to clear the colon and rectum of fecal contents. Sodium picosulfate/magnesium citrate may be associated with a dehydrating effect, as evidenced by a reduction in bodyweight and increased hemoglobin levels; some at-risk patients may experience postural hypotension and older patients.<sup>35</sup> A study investigating the quality of cleansing of sodium picosulfate (Picopreparation-3™, Pharmatel Fresenius Kabi Pty Ltd, Pymble, NSW, Australia) with different administration schedules concluded the worse quality of bowel preparation was associated with the afternoon procedures and the prior history of the constipation.<sup>36</sup>

For countries which do not have sodium picosulfate, a reasonable alternative is magnesium citrate (1 bottle, around 300 mL) the evening before the procedure plus either bisacodyl tablets at the same time as the magnesium citrate or enema immediately before the procedure. However, literacy comparing efficacy of magnesium citrate in combination with bisacodyl or enemas and PEG or NaP solutions, is sparse.

## **2.2 Adjuncts to bowel preparation**

### **2.2.1 Diet**

Dietary modifications alone, such as clear liquids, are inadequate for colonoscopy but have proven benefit as an adjunct to other cleansing methods by decreasing the formation of solid residue. Clear liquids also help maintain adequate hydration during bowel preparation and are recommended with all bowel preparation regimens.

### **2.2.2 Stimulant laxatives**

High dose senna has been used alone for bowel preparation and studies have shown comparable efficacy and better compliance. But the limiting factors were higher incidence of abdominal pain. Recently, the adjunctive use of low dose senna with PEG solutions has been demonstrated to improve the quality of bowel preparation<sup>36</sup> and to reduce the amount of PEG-ELS required for effective bowel preparation.<sup>41</sup> This also reduces the abdominal pain reported with high dose senna. Bisacodyl (2-4 tablets of 5 mg each) and low-dose senna (36 mg, about 4 tablets of 8.6 mg Sennakot) are now commonly used as an adjunct to low-volume PEG, achieving similar results to full-volume PEG. Based on the type of study, these agents are given within 2 to 6 hours before starting of PEG solution.<sup>37</sup>

### **2.2.3 Hyperosmolar laxatives**

Magnesium citrate (1 bottle, about 300 cc) alone is also commonly used as an adjunct to low volume PEG solution with equivalent efficacy to high volume PEG solutions. In contrast, the routine use of non-absorbable carbohydrates such as mannitol and lactulose is not favored for bowel preparation since the hydrogen gas produced by bacterial fermentation of the non-absorbed carbohydrates increases the risk of explosion during electrosurgical procedures.<sup>38</sup>

### **2.2.4 Antiemetic agents**

Metoclopramide (5- 10 mg), a dopamine antagonist gastroprokinetic that sensitizes tissues to the action of acetylcholine, is commonly used to address the nausea or vomiting associated with bowel preparation agents.<sup>39</sup>

In patients who are intolerant to metoclopramide or are at high-risk for metoclopramide related side effects (such as in elderly), alternative anti-emetic agents such as promethazine (Phenergan) or ondansetron (Zofran) can be prescribed.

### **2.2.5 Antifoaming agent**

Simethicone (3 tablets of 80 mg each, total 240 mg dose), an anti-flatulent, anti-gas agent, is prescribed by many gastroenterologists in an attempt to reduce bubbles during colonoscopy and improve the visibility. It works by reducing the surface tension of air bubbles and causing the coalescence of small bubbles into larger ones that pass more easily with belching or flatulence.<sup>40</sup>

### 2.2.6 Enemas

Enemas are sufficient for flexible sigmoidoscopies but when used alone do not permit adequate visualization of the proximal colon during colonoscopies. They are best used as adjuncts to other bowel preparation agents when patients present with poor distal colon preparation for colonoscopy. Enemas are also useful in washing out the distal segment of bowel in patients with a proximal stoma or a de-functioned distal colon. There have been studies comparing magnesium citrate with hypertonic enemas or oral bisacodyl as the bowel preparation for sigmoidoscopy over the use of hypertonic phosphate enemas alone. It was shown that there is no statistical difference between the quality of the three bowel preparations.<sup>42</sup> In one study inadequately prepared patients during a 19-month period were successfully cleansed of their retained fecal contents with enemas, permitting satisfactory colonoscopic examinations.<sup>21</sup> Thus, for the management of patients who are sub-optimally prepared for colonoscopic examination because of retained fecal material the use of colonoscopic enema proves to be effective by avoiding the need for postponement of the procedure.<sup>43</sup>

The common types of enema are tap water, soap suds, Fleet (NaP), Fleet-Bisacodyl and mineral oil enemas

### 2.2.7 Tap water enemas

500 cc to 1L tap water enemas are commonly used for bowel cleansing on the evening prior or the morning of the procedure along with the dietary restrictions and cathartics, especially for flexible sigmoidoscopies. They usually work within 10–15 minutes but may need to be repeated one or two times to thoroughly cleanse the bowel in preparation for a bowel exam or bowel surgery. In general, tap water enemas are thought to be mild enemas and may be less effective than other forms of enemas. They have fewer side effects than NaP enemas though large or repeated amounts of tap water can still lead to electrolyte imbalances as the water is absorbed through the rectum and colon. Some people differentiate between high and low enemas. A high enema is usually administered at higher pressure and with larger volume (1,000 cc), and the patient is asked to change position several times in order for the fluid to flow up into the bowel. A low enema is administered at lower pressure, using about 500 cc of fluid.

### 2.2.8 Soap suds enemas

Soap suds enemas are thought to be more effective than plain tap water enemas. Soaps act as surfactant and make water a more aggressive solvent. This allows the bowel content to become more liquid. Soaps are also irritant to colon and lead to increased peristalsis and evacuation of bowel content. Some soaps are safer to use than others. In general, 2 to 3 drops of hand soap are added into an enema bag filled with 2 quarts of warm filtered water.

### 2.2.9 NaP enemas

Sodium Biphosphate (Fleet enemas) can be used for bowel cleansing before sigmoidoscopy. However this should be avoided in elderly and in those with renal failure because of the risk of developing hyperphosphatemia and subsequent hypocalcemia. In one study, one hundred and two consecutive patients were randomized: 56 to the Fleet enema group and 46 to the Picolax group (sodium picosulfate + magnesium citrate). It was found that Fleet enemas provided a significantly superior bowel preparation with 93% being judged as

adequate or better as opposed to 74% in the Picolax group. In addition Fleet enemas were associated with lesser adverse symptoms. It was thus concluded that Fleet enema is superior to Picolax in terms of bowel preparation for flexible sigmoidoscopy and the incidence of associated adverse symptoms.<sup>44</sup>

### 2.2.10 Mineral oil enemas

Mineral Oil is a lubricant laxative that works by slowing the absorption of water from the bowel which softens the stool. They are best reserved for refractory constipation. Possible side effects of mineral oil enema are:

- Bloating, diarrhea, gas, nausea, stomach cramps.
- Mineral oil enema is not recommended for use in children younger than 2 years of age. Safety and effectiveness in this age group have not been confirmed.
- Pregnancy and Breastfeeding: If the patient becomes pregnant, it is advised to discuss with their doctor the benefits and risks of using Mineral Oil Enema during pregnancy. It is unknown if Mineral Oil Enema is excreted in breast milk. Breastfeeding patients must discuss the potential side effects with their doctor.
- Patients should seek medical attention right away if any of these SEVERE side effects occur:
  - Severe allergic reactions (rash; hives; difficulty breathing; tightness in the chest; swelling of the mouth, face, lips, or tongue); dizziness.
  - Failure to have a bowel movement within 6 to 8 hours after using Mineral Oil Enema; fainting; muscle cramps or pain; rectal bleeding; swelling, pain, or irritation; weakness

### 2.2.11 Bisacodyl enemas

A laxative which is used for treating constipation can also be used to empty the bowel before surgery and examinations such as X-Ray procedures using Barium enema. Bisacodyl can be used as tablet, suppository or as enema. It can also be combined with NaP and other enemas. However due precautions must be taken in the following cases.

1. If the patient is allergic to Bisacodyl, aspirin or any ingredients in these products.
2. In case the patient is pregnant, Breast-feeding or plans to become pregnant.

The side effects that may be experienced during the use of Bisacodyl enema are:

- stomach cramps
- upset stomach
- diarrhea
- stomach and intestinal irritation
- faintness
- irritation or burning in the rectum (from suppositories)

### 2.2.12 Nasogastric tubes

Nasogastric tubes have been used to instill colonic preparations, especially for inpatients not able to drink PEG solutions or those who are unresponsive or mechanically ventilated. It can also be useful for rapid bowel cleansing

(within 2 to 3 hours) for patients with lower gastrointestinal bleeding. However, routine use of nasogastric tube solely for bowel preparation is discouraged as it can lead to severe complications, such as aspiration, in addition to trauma, during insertion.<sup>44</sup>

## **2.3 Special situations**

### **2.3.1 Capsule endoscopy**

Our practice has been to place all patients on clear liquid diet and limit the bowel preparation to patients who have recently taken or actively taking iron supplements. On the other hand, some practices routinely use oral bowel preparation for capsule endoscopy not only to clean the colon, but also to promote capsule propulsion. For hospitalized patients who are unable to take bowel preparation easily, we recommend use of nasogastric tube to deliver PEG solutions before capsule endoscopy, whenever indicated.

### **2.3.2 Pouchoscopy**

Patients are usually prepared by taking clear liquids for 1 day before the procedure. Some practices (including ours) routinely use enemas to clear the pouch and distal small bowel before pouchoscopies. Full bowel preparation is not required for pouchoscopies.

### **2.3.3 Ileostomy and colostomy**

Bowel preparation is not needed for scoping through the ileostomy and in-fact may be relatively contraindicated in some cases due to the risk of increasing stoma output and causing dehydration. Bowel preparation for colostomy varies by site of colostomy and practice preference. For sigmoid colostomy, many physicians chose to give full bowel preparation. It is also preferable if the patients are on clear liquids for 1 day before the procedure, especially if they have a colostomy.

### **2.3.4 Flexible sigmoidoscopy**

Usually, enemas given within 2 hours of examination are adequate for bowel preparation for flexible sigmoidoscopy. Clear liquid diet for 1 day before procedure is optional. If patients are having diarrhea, then enemas are unnecessary. Many physicians chose not to give enemas to patients who have severe colitis, because of ongoing diarrhea and the potential for increased perforation risk.

### **2.3.5 Decompressive colonoscopy for megacolon**

Decompressive colonoscopy is an exception when it comes to bowel preparation. Endoscopic decompression of the colon relieves acute pseudo-obstruction and megacolon in about 85% of patients but is associated with a perforation rate of about 2%. Because of the risk for colonic perforation, oral bowel preparation or enemas are avoided in these patients and decompressive colonoscopy is best done in unprepped bowel. Patients are mostly NPO in these settings.

### **2.3.6 Stricturing disease**

In our experience, many patients with ileal or colon strictures can successfully tolerate bowel preparation (including PEG). However, their symptoms need to be watched carefully and bowel preparation should be withheld if any significant nausea, vomiting or abdomen pain develops. Patients with high-grade strictures may not tolerate oral bowel preparation and may need enemas. Bowel preparation is contraindicated in patients with suspicion of bowel obstruction.

<p><b>2 weeks before colonoscopy:</b></p>	<p><b>Please let your primary care physician or the prescribing physician know if you are</b>          Taking blood thinners or antiplatelet agents such as warfarin(Coumadin), enoxaparin (Lovenox), fondaparinux (Arixtra), clopidogrel (Plavix), ticlopidine (Ticlid), anagrelide (Agrylin),cilostazol (Pletal), pentoxyphylline (trental), dipyridamole (Persantine) with aspirin (Aggrenox)          Over-the-counter medications like aspirin or other anti-inflammatory medications (motrin, advil, aleve etc) might need to be stopped as well          Have diabetes and take insulin. You may need to have your insulin adjusted the day before and the day of the procedure          It is important to continue to take all other prescribed medications</p>
<p><b>2-5 days before the procedure:</b></p>	<p>If you tend to be constipated, maintain clear, liquid diet for two days prior to the exam.          Do not take bulk-forming agents (such as Metamucil, Citrucel etc.)          Do not take iron-containing preparations (such as multi-vitamins containing iron)          Do not consume dairy products.          Arrange for a driver to take you back home after the procedure          Purchase your prescription 2 - 5 days before colonoscopy. Do not mix the solution until the before colonoscopy</p>
<p><b>Evening of the exam:</b></p>	<p>Do not add sugar or flavorings containing sugar to the solution. Refrigerating the solution, adding lemon juice or Crystal Lite and rapidly drinking 8 ounce portions (instead of sipping) may help.          At 6:00 p.m. the evening before the procedure, begin drinking 8 ounces (240 ml, one cup) of the GoLYTELY every 15- 20 minutes until half of the solution is ingested. Continue drinking clear liquids until you go to bed.          Do not eat solid foods for 24 hours before colonoscopy appointment.          Do not take alcohol          Do not take red-colored drinks, Jell-O or popsicles          It is essential to drink at least 8 ounces of clear liquids (1 cup) every hour while awake to avoid dehydration. Clear liquids include:          - apple or white grape juice          - broth          - coffee or tea (without milk or creamer)          - clear carbonated beverages, such as ginger ale or lemon-lime soda          - Gatorade or other sports drinks (not red)          - Kool-Aid or other flavored drinks (not red)          - plain Jell-O or other gelatins (not red)          - popsicles (not red)          - water          Some people do experience nausea when drinking so much liquid, so the physician may prescribe an anti-nausea medication in case it is needed. Golytely now comes in several flavors to make it easier to drink.</p>

<p><b>Morning of the exam:</b></p>	<p>Ask your doctor if you should take any of your medicines the morning of your test. If so, take with sips of water only.</p> <p>If you have an afternoon appointment, begin drinking remaining GoLYTELY about 8 ounces every 10 minutes at 6:00 a.m. on the morning of the procedure, until finished at approximately 8:00 a.m. If your procedure is scheduled in early morning, you will need to get up in the night to finish the second half of GoLYTELY at least 2-3 hours before the colonoscopy appointment or complete the entire GoLYTELY in the evening before the procedure.</p> <p>You should drink clear liquids at least 8 ounces of clear liquids every hour (no solids, alcohol or red colored drinks) until 2 hours before colonoscopy appointment. You may take your morning medications.</p> <p>If the eliminations do not become clear after the gallon is finished an enema may be needed</p>
<p><b>After the exam:</b></p>	<p>The colonoscopy generally takes 30-60 minutes</p> <p>You must have someone else drive you back home as sedation might take some time to wear off</p> <p>You can resume the solid diet on the same day after the procedure. You however should continue taking more liquids. After the colonoscopy, you are encouraged to drink fluids to prevent dehydration.</p>

## 2.4 Patient Instructions

Educating patients about bowel preparation instructions is critical for ensuring adequate bowel preparation and helps reduce the risk of preparation related adverse events. Patients on blood thinners, or who are diabetics, need additional instructions from their treating physicians to find the best approach in continuing or withholding some of their medications during bowel preparation.

### 2.4.1 General patient instruction sheet for split-dose PEG administration (with permission from Cleveland Clinic)

Follow the schedule in the table below for your bowel preparation. You may need to get to the toilet right away. You will have many bowel movements through the day. They will become very watery. The bowels are clear or clean when there is only pale yellow fluid without flecks of stool.

### 2.4.2 Key role of adequate hydration

One of the key concepts to emphasize to patients is the need for adequate hydration during bowel preparation. Many patients mistakenly believe that taking 4 L of polyethylene glycol obviates the need for additional hydration, since they are already ingesting such a large volume of fluid. Given that bowel preparations induce diarrhea and, in some instances, nausea and decreased oral intake, all patients taking bowel preparations are at risk of dehydration.<sup>32</sup> Hence, many safety issues associated with bowel preparation agents are related to dehydration and its complications.

In general, patients should be advised to consume at least 64 oz (approximately 2 L) of clear fluid on the day before the colonoscopy. According to the American Society of

Anesthesiologists, clear liquids can be safely ingested up until 2 hours before receiving anesthesia.<sup>33</sup> Patients should also be advised to keep drinking extra fluids after the procedure is completed to reduce the risk of dehydration and its complications

### 3. Conclusion

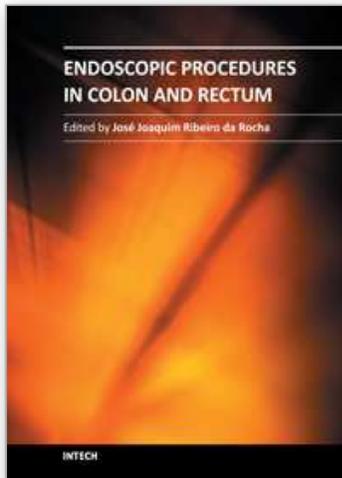
Adequate bowel preparation is essential before colonoscopy. Choosing an agent can be confusing, especially with so many agents available in the market today. Polyethylene glycol solutions are safe and effective, and are the preferred agents for cleansing the colon. Sodium phosphate can still be prescribed for patients who cannot tolerate polyethylene glycol solutions, provided they are not at risk of electrolyte or fluid imbalances. Enemas, bisacodyl, and metoclopramide are mainly used as adjuncts to polyethylene glycol but by themselves are inadequate for cleansing the entire colon. In this chapter, we have reviewed the advantages and disadvantages of available regimens, provided bowel preparation instructions for patients and emphasized the need to consider split-dose regimens as well as the need for adequate hydration before and after colonoscopy.

### 4. References

- [1] Wexner SD, Beck DE, et al. A consensus document on bowel preparation before colonoscopy: preparation prepared by a task force from the American Society of Colon and Rectal Surgeons (ASCRS), the American Society for Gastrointestinal Endoscopy (ASGE), and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES). *Dis Colon Rectum*. 2006; 49(6):792-809
- [2] Harewood GC, Sharma VK, Et al. Impact of colonoscopy preparation quality on detection of suspected colonic neoplasia. *Gastrointest Endosc*. 2003 ;58(1):76-9.
- [3] Hendry PO, Jenkins JT, et al. The impact of poor bowel preparation on colonoscopy: a prospective single centre study of 10,571 colonoscopies. *Colorectal Dis*. 2007;9(8):745-8.
- [4] Golub RW, Kerner BA, et al. Colonic preparations-which one? A blinded, prospective, randomized trial. *Dis Colon Rectum* 1995;58:594-7.
- [5] Marshall JB, Pineda JJ, et al. Prospective, randomized trial comparing sodium phosphate solution with polyethylene glycol electrolyte lavage for colonoscopy preparation. *Gastrointest Endosc* 1993;39:631-4.
- [6] DiPalma JA, Marshall JB, et al. Comparison of a new sulfate-free polyethylene glycol lavage solution versus a standard solution for colonoscopy cleansing. *Gastrointest Endosc* 1990;36:285-9.
- [7] DiPalma JA, Wolff BG, et al. Comparison of reduced volume versus four liters sulfate-free electrolyte lavage solutions for colonoscopy colon cleansing. *Am J Gastroenterol* 2003; 98:2187-2191.
- [8] Adams WJ, Meagher AP, et al Bisacodyl reduces the volume of polyethylene glycol solution required for bowel preparation. *Dis Colon Rectum* 1994; 37:229-233.
- [9] Sharma VK, Steinberg EN, et al. Randomized, controlled study of pretreatment with magnesium citrate on the quality of colonoscopy preparation with polyethylene glycol electrolyte lavage solution. *Gastrointest Endosc* 1997; 46:541-543.
- [10] Stratton S, Shelton P, et al. Feasibility of polyethylene glycol (PEG) 3350 (Miralax) for colon pre paration prior to lower endoscopic examination in healthy adults; experience in a community clinic setting. *Dig Dis Sci* 2011 Feb;56(2):273-5.

- [11] Clark LE, DiPalma JA, et al. Safety issues regarding colonic cleansing for diagnostic and surgical procedures. *Drug Saf.* 2004;27:1235-42.
- [12] Nelson DB, Barkun AN, et al. Technology Status evaluation report. Colonoscopy preparation, May 2001. *Gastrointest Endosc.* 2001; 54; 829-32.
- [13] Sharma VK, Steinberg EN, et al. Randomized, controlled study of pretreatment with magnesium citrate on the quality of colonoscopy preparation with polyethylene glycol electrolyte lavage solution. *Gastrointest Endosc.* 1997;46:541-3.
- [14] Adams WJ, Meagher AP, et al. Bisacodyl reduces the volume of PEG solution required for bowel preparation. *Dis Colon Rectum.* 1994;27:229-33.
- [15] Haapamäki MM, Lindström M, et al. Low-volume bowel preparation is inferior to standard 4 l polyethylene glycol. *Surg Endosc.* 2011 Mar;25(3):897-901.
- [16] Coporaal S, Kleibeuker JH, et al. Low-volume PEG plus ascorbic acid versus high-volume PEG as bowel preparation for colonoscopy. *Scand J Gastroenterology* 2010 Nov; 45(11): 1380-6.
- [17] Marmo R, Rotondano G, et al. Effective bowel cleansing before colonoscopy: a randomized study of split-dosage versus non-split dosage regimens of high-volume versus low-volume polyethylene glycol solutions. *Gastrointest Endosc.* 2010 Aug;72(2):313-20.
- [18] Abut E, Guveli H, et al. Administration of olive oil followed by a low volume of polyethylene glycol-electrolyte lavage solution improves patient satisfaction with right-side colonic cleansing over administration of the conventional volume of polyethylene glycol-electrolyte lavage solution for colonoscopy preparation. *Gastrointest Endosc.* 2009;70(3):515-21.
- [19] Hjelkrem M, Stengel J, et al. MiraLAX Is Not as Effective as GoLytely in Bowel Cleansing Before Screening Colonoscopies. 2011;9(4):326-332.e1.
- [20] Enestyedt BK, Fennerty MB, et al. Randomised clinical trial: MiraLAX vs. Golytely - a controlled study of efficacy and patient tolerability in bowel preparation for colonoscopy. 2011;33(1):33-40.
- [21] Rex DK, Johnson DA, et al. American College of Gastroenterology Guidelines for Colorectal Cancer Screening 2008. *Am J Gastroenterol* 2009;104:739-750.
- [22] Rex DK, Imperiale TF, et al. Impact of bowel preparation on efficiency and cost of colonoscopy. *Am J Gastroenterol* 2002; 97:1696-1700.
- [23] El Sayed AM, Kanafani ZA, et al. A randomized single-blind trial of whole vs. split-dose polyethylene glycol-electrolyte solution for colonoscopy preparation. *Gastrointest Endosc* 2003;58:36-40.
- [24] Rostom A, Jolicoeur E, et al. A randomized prospective trial comparing different regimens of oral sodium phosphate and polyethylene glycol-based lavage solution in the preparation of patients for colonoscopy. *Gastrointest Endosc* 2006;64:544-552.
- [25] Park JS, Sohn CI, et al. Quality and effect of single dose vs. split dose of polyethylene glycol bowel preparation for early-morning colonoscopy. *Endoscopy.* 2007 Jul;39(7):616-9
- [26] Singal AK, Rosman AS, et al. The renal safety of bowel preparations for colonoscopy: a comparative study of oral sodium phosphate solution and polyethylene glycol. *Aliment Pharmacol Ther.* 2008;27(1):41-47.
- [27] Russmann S, Lamerato L, et al. Risk of impaired renal function after colonoscopy: a cohort study in patients receiving either oral sodium phosphate or polyethylene glycol. *Am J Gastroenterol.* 2007;102(12):2655-2663.

- [28] Markowitz GS, Stokes MB, et al. Acute phosphate nephropathy following oral sodium phosphate bowel purgative: an underrecognized cause of chronic renal failure. *J Am Soc Nephrol.* 2005;16(11):3389-3396.
- [29] Hookey LC, Depew WT, et al. The safety profile of Oral sodium phosphate for colon cleansing before colonoscopy in adults. *Gastrointestinal Endos.* 2002;56:895-902.
- [30] Rex DK, Schwartz H, et al. Safety and colon-cleansing efficacy of a new residue-free formulation of sodium phosphate tablets. *Am J Gastroenterol.* 2006;101:2594-2604
- [31] Aihara H, Saito S, et al. Comparison of two sodium phosphate tablet-based regimens and a polyethylene glycol regimen for colon cleansing prior to colonoscopy: a randomized prospective pilot study. *Int J Colorectal Dis.* 2009 Sep;24(9):1023-30.
- [32] Wruble L, Demicco M, et al. Residue-free sodium phosphate tablets (OsmoPrep) versus Visicol for colon cleansing *Gastrointest Endosc.* 2007 Apr;65(4):660-70.
- [33] Juluri R, Eckert G, et al. Meta-analysis: randomized controlled trials of 4-L polyethylene glycol and sodium phosphate solution as bowel preparation for colonoscopy. *Alimentary Pharmacol Ther.* 2010 Jul;32(2):171-81.
- [34] Curran MP, Plosker GL, et al. Oral sodium phosphate solution: a review of its use as a colorectal cleanser. *Drugs.* 2004;64(15):1697-714.
- [35] Hoy SM, Scott LJ, et al. Sodium picosulfate/magnesium citrate: a review of its use as a colorectal cleanser. *Drugs.* 2009;69(1):123-36
- [36] Varughese S, Kumar AR, et al. Morning-only one-gallon polyethylene glycol improves bowel cleansing for afternoon colonoscopies: a randomized endoscopist-blinded prospective study. *Am J Gastroenterology* 2010 Nov;105(11):2368-74.
- [37] Ziegenhagen DJ, Zehnter E, et al. Addition of Senna improves colonoscopy preparation with lavage: a prospective randomized trial. *Gastrointest Endosc* 1991;37(5):547-9.
- [38] Bigard MA, Gaucher P, Lassalle C. Fatal colonic explosion during colonoscopic polypectomy. *Gastroenterology* 1979; 77:1307-1310.
- [39] Rhodes JB, Engstrom J, Stone KF. Metoclopramide reduces the distress associated with colon cleansing by an oral electrolyte overload. *Gastrointest Endosc* 1978; 24:162-163.
- [40] Wu L, Cao Y, Liao C, Huang J, Gao F. Systematic review and meta-analysis of randomized controlled trials of Simethicone for gastrointestinal endoscopic visibility. *Scand J Gastroenterol.* 2011;46(2):227-35.
- [41] Iida Y, Miura S, et al. Bowel preparation for the total colonoscopy by 2000 ml of balanced lavage solution (GoLyteLy) and sennoside. *Gastroenterol Jpn* 1992; 27(6):728-33.
- [42] Fincher RK, Osgard EM, et al. Comparison of bowel preparations for flexible sigmoidoscopy: oral magnesium citrate combined with oral bisacodyl, one hypertonic phosphate enema, or two hypertonic phosphate enemas. *Am J Gastroenterol.* 1999;94(8):2122-7.
- [43] Sohn N, Weinstein MA, et al. Management of the poorly preparationed colonoscopy patient: colonoscopic colon enemas as a preparation for colonoscopy. 2008;51(4):462-6.
- [44] P.J Drew, M. Hughes, et al. The optimal bowel preparation for flexible sigmoidoscopy. *European Journal of surgical oncology,* 1997; 23:315-316.



## **Endoscopic Procedures in Colon and Rectum**

Edited by Prof. Jose Ribeiro Da Rocha

ISBN 978-953-307-677-5

Hard cover, 156 pages

**Publisher** InTech

**Published online** 07, November, 2011

**Published in print edition** November, 2011

Endoscopic procedures in colon and rectum presents nine chapters which start with introductory ones like screening by colonoscopy as the preparation and monitoring for this exam. In addition to these approaches the book aims in the last four chapters to explain endoscopic diagnostic and therapeutic aspects in the colon and rectum. The description of each text is very comprehensive, instructive and easy to understand and presents the most current practices on the topics described. This book is recommended for general and colorectal surgeons as it presents guidelines for diagnosis and treatment which are very well established.

### **How to reference**

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Sansrita Nepal, Ashish Atreja and Bret A Lashner (2011). Optimal Bowel Preparation for Colonoscopy, Endoscopic Procedures in Colon and Rectum, Prof. Jose Ribeiro Da Rocha (Ed.), ISBN: 978-953-307-677-5, InTech, Available from: <http://www.intechopen.com/books/endoscopic-procedures-in-colon-and-rectum/optimal-bowel-preparation-for-colonoscopy>

**INTECH**  
open science | open minds

### **InTech Europe**

University Campus STeP Ri  
Slavka Krautzeka 83/A  
51000 Rijeka, Croatia  
Phone: +385 (51) 770 447  
Fax: +385 (51) 686 166  
[www.intechopen.com](http://www.intechopen.com)

### **InTech China**

Unit 405, Office Block, Hotel Equatorial Shanghai  
No.65, Yan An Road (West), Shanghai, 200040, China  
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元  
Phone: +86-21-62489820  
Fax: +86-21-62489821

© 2011 The Author(s). Licensee IntechOpen. This is an open access article distributed under the terms of the [Creative Commons Attribution 3.0 License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

IntechOpen

IntechOpen