Variables in the preparation of the large intestine for double contrast barium enema examination

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SUMMARY This study examines which methods are most appropriate for preparation of the large bowel for double contrast barium enema. Two proprietary laxatives, X-Prep and Picolax, mechanical colonic lavage, and dietary restriction were evaluated in a randomised study of 160 patients. Four alternative preparations were compared with or without dietary restriction. The four preparations were X-Prep alone, X-Prep plus lavage, Picolax alone, and Picolax plus lavage. Scoring of the radiographs was carried out on a double blind basis. Picolax proved superior to X-Prep overall (p<0.01) but this was almost entirely because of its greater effect in the right colon and transverse colon. Cleansing in the left colon and rectosigmoid was similar with both laxatives. Restriction of solid food improved bowel cleansing and gave better results than mechanical lavage. The addition of a colonic lavage in starved patients did not significantly improve the quality of bowel preparation with either laxative.

A clean bowel is an important prerequisite for the demonstration of mucosal anatomy by barium enema examination. Three principal factors are involved in cleansing the colon of faecal material: dietary restriction, laxatives, and mechanical colonic lavage. The relative importance of these factors has not been established despite the large number of barium enema examinations that have been performed. We have therefore compared two commonly used laxatives and the effects of dietary restriction and colonic lavage for preparation before barium enema examination.

Methods

One hundred and sixty consecutive patients referred for barium enema examinations were randomly allocated to one of eight study groups each of 20 patients (Table 1). Patients with diabetes and those previously treated by colonic resection were excluded. The nature of the preparation for each group of 20 patients is summarised in Table 1.

LAXATIVES

X-Prep contains 142 mg sennosides A + B in 71 ml solution. It was taken orally in the afternoon before the examination. Picolax contains 13 g magnesium citrate and 10 mg sodium picosulphate in each sachet. Patients were asked to take one sachet mixed with water during the morning before the examination and a second sachet eight hours later.

LAVAGE.

Mechanical lavage was performed three hours before the enema examination using a Henderson lavage machine until the returning fluid was clear.

DIETARY RESTRICTION

Dietary restriction involved the patient not taking any solid food from 10.00 pm of the evening two days before the examination. Patients were asked to stop taking iron tablets and to avoid bran and similar substances in the three days before the examination. All patients in each group were asked

<table>
<thead>
<tr>
<th></th>
<th>X-Prep</th>
<th>X-Prep + lavage</th>
<th>Picolax</th>
<th>Picolax + lavage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal diet</td>
<td>Group 1</td>
<td>Group 3</td>
<td>Group 5</td>
<td>Group 7</td>
</tr>
<tr>
<td>Dietary</td>
<td>Group 2</td>
<td>Group 4</td>
<td>Group 6</td>
<td>Group 8</td>
</tr>
<tr>
<td>restriction</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

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to take liberal amounts of fluid by mouth during the preparation period. Milk and other milk based products were excluded.

**BARIUM ENEMA TECHNIQUE**

Barium enema examinations were performed by one of two radiologists using a standardised technique involving nine films for each patient. All patients were given 20 mg hyoscine butylbromide intravenously during the examination.

**RADIOLOGICAL ASSESSMENT**

The films were assessed by one radiologist (JRL) who was unaware of the preparative technique used. The radiographs were scored using the system described by Dodds et al (Table 2) as either excellent, good, fair, poor, or unacceptable in each of four areas of the colon (ascending, transverse, and descending colon, and recto-sigmoid). As an estimate of cleansing was made in each colonic segment, there was a total of 80 gradings in each group of 20 patients.

**SIDE EFFECTS ON PATIENTS**

After the barium enema examination, each patient recorded any nausea, vomiting, abdominal pain, or faecal incontinence by completing a questionnaire.

**STATISTICAL ANALYSIS**

The results of cleansing were analysed by the Mann–Whitney U test, and patient side effects by the χ² test.

**Results**

The random allocation of ambulant patients to the trial achieved fairly even distribution of patients as regards sex, age, and colonic pathology. No group had more than two patients with neoplasms, strictures (either diverticular or neoplastic), or inflammatory bowel disease. The most common pathological condition in any group was mild diverticular disease. The scores for each of the eight groups are shown in Table 3.

**DIRECT COMPARISON BETWEEN LAXATIVES**

There was no significant difference between X-Prep and Picolax, or between X-Prep plus lavage and Picolax plus lavage. With dietary restriction Picolax was significantly better than X-Prep (p<0.05). Picolax plus starvation and lavage was significantly better than the comparable X-Prep group (p<0.001).

**EFFECT OF STARVATION**

Dietary restriction gave significantly better results with X-Prep over X-Prep alone (p<0.01) and with Picolax over Picolax alone (p<0.001). X-Prep, starvation and lavage was superior to X-Prep and lavage (p<0.001). Picolax, starvation and lavage was better than Picolax and lavage (p<0.001).

**EFFECT OF COLONIC LAVAGE**

There was no significant difference between X-Prep and X-Prep plus lavage or between Picolax and Picolax plus lavage. There was no significant difference between X-Prep plus starvation and X-Prep, starvation and lavage, or between Picolax plus starvation and Picolax, starvation and lavage.

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**Table 2  Scoring system for colon cleaning**

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>No retained faecal material</td>
</tr>
<tr>
<td>Good</td>
<td>Minimal faecal material, few fine particles, 1-2 mm in diameter</td>
</tr>
<tr>
<td>Fair</td>
<td>Moderate faecal debris, particles 5 mm or less, not sufficient to invalidate examination</td>
</tr>
<tr>
<td>Poor</td>
<td>Considerable faecal material, particles less than 1 cm, sufficient to compromise examination</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>Abundant faecal material, particles 1 cm or more</td>
</tr>
</tbody>
</table>

**Table 3  Evaluation of bowel cleanliness for each preparation group**

<table>
<thead>
<tr>
<th>Laxative alone</th>
<th>Laxative + starvation</th>
<th>Laxative + colonic lavage</th>
<th>Laxative + starvation + colonic lavage</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-Prep</td>
<td>X-Prep</td>
<td>X-Prep</td>
<td>X-Prep</td>
</tr>
<tr>
<td>Picolax</td>
<td>Picolax</td>
<td>Picolax</td>
<td>Picolax</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Score</th>
<th>X-Prep Picolax</th>
<th>X-Prep Picolax</th>
<th>X-Prep Picolax</th>
<th>X-Prep Picolax</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>22 22</td>
<td>35 46</td>
<td>24 33</td>
<td>1 1</td>
</tr>
<tr>
<td>Good</td>
<td>25 25</td>
<td>30 20</td>
<td>28 21</td>
<td>38 59</td>
</tr>
<tr>
<td>Fair</td>
<td>24 15</td>
<td>11 8</td>
<td>13 17</td>
<td>24 13</td>
</tr>
<tr>
<td>Poor</td>
<td>9 18</td>
<td>4 3</td>
<td>15 9</td>
<td>15 5</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>15 10</td>
<td>8 3</td>
<td>15 9</td>
<td>2 2</td>
</tr>
</tbody>
</table>
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Comparison between starvation and colonic lavage

X-Prep plus starvation was significantly better than X-Prep plus lavage (p<0.02) and Picolax with starvation gave significantly greater cleansing than Picolax with lavage (p<0.01).

The scores for the four groups having X-Prep and the comparable Picolax groups are shown in Table 4. Picolax tended to give better bowel cleansing than X-Prep in the right colon and significantly less faecal residue in the transverse colon (p<0.02). In the left colon and recto-sigmoid region, however, the scores for the two laxatives were similar, and no significant difference was observed. The sum of the scores for the four X-Prep and four Picolax groups is shown in Table 5. Picolax overall gave better results than did X-Prep (p<0.01).

Barium mucosal coating

The coating of mucosa with barium tended to be rather thick in patients given Picolax and lavage, especially in the right colon. In all other groups the barium coating was satisfactory. Some of the examinations were not diagnostic owing to residual faeces.

Side effects on patients

The results are given in Table 6. The only significant difference between the two laxative groups was an increased incidence of nausea in patients receiving X-Prep alone (p<0.05).

Discussion

Dietary restriction should lessen the amount of faecal residue in the large bowel, and indeed most regimes for bowel cleansing for barium enema examinations include some form of dietary restriction. The degree of restriction, however, varies widely and often includes a complex detailed dietary regime. In this study, we gave a simple instruction to patients in the dietary groups that they should avoid all solid, milk or milky products from a given time. This single clear instruction was readily understood and followed. As laxatives increase the secretion of water and electrolyte into the bowel lumen patients were instructed to drink liberal amounts of fluid. Frequent drinks probably reduce the appetite and this helps patients to adhere to food restriction. Our results show that restricting the amount of solid food ingested plays an important part in bowel cleansing. It would be useful to determine whether the period of starvation could be reduced without compromising the bowel cleanliness. The effectiveness of starvation and dietary restriction depends upon the patient’s compliance and some patients will do this better than others.

It proved more reliable to reduce residue by starvation rather than removing it by mechanical means. The addition of a colonic lavage did not significantly reduce the large bowel faecal residue in either of the laxative groups, although the outcome must depend upon the technical excellence of mechanical lavage. In some centres mechanical colonic lavage can undoubtedly produce excellent results. Unfortunately, this is not universal and results vary among hospitals. During the period of our trial, lavage was performed by several nurses and this may account in part for the indifferent results from lavage. In our experience the short interval between lavage and barium enema resulted in the residual fluid in the colon diluting the barium with subsequent poor mucosal coating. We allowed about three hours between the two procedures; this

Table 4  Assessment of bowel preparation for each anatomical site in the colon for all four groups of patients receiving either X-Prep (A) or Picolax (B)

<table>
<thead>
<tr>
<th></th>
<th>Right colon</th>
<th>Transverse colon</th>
<th>Left colon</th>
<th>Sigmoid and rectum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Excellent</td>
<td>3</td>
<td>17</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Good</td>
<td>24</td>
<td>19</td>
<td>40</td>
<td>15</td>
</tr>
<tr>
<td>Fair</td>
<td>32</td>
<td>23</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Poor</td>
<td>5</td>
<td>7</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>21</td>
<td>21</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>
may be too long, allowing continued contamination of the right colon.

The superior cleansing effect of Picolax in the proximal part of the colon may be due to its mode of action, which differs from X-Prep. The latter consists wholly of senna, which is probably activated by bacteria in the large bowel and therefore has no laxative effect until it reaches the colon. It is possible that the activation process is incomplete in the proximal large bowel and is only effective in the distal colon. Picolax is a combination of magnesium citrate and sodium picosulphate. The latter component behaves like senna and requires activation by colonic bacteria. Magnesium citrate, however, may produce good mechanical cleansing in the proximal colon by a large, osmotic flow of fluid from the small bowel.

We have evaluated two proprietary laxatives and used them in the recommended dosage. Picolax was given in divided doses. Our experience with magnesium citrate alone in an equivalent single dose suggests that dividing the dose has little effect.

In conclusion, we would recommend dietary restriction and Picolax without mechanical lavage for routine bowel preparation before double contrast barium enema examination.

References


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