Is Bowel Preparation Necessary Before kidney-Ureter-Bladder Radiography and Intravenous Urography?

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Received August 2011
Accepted January 2012

Purpose: To assess whether bowel preparation prior to kidney-ureter-bladder (KUB) radiography and intravenous urography (IVU) are of value in improving visualization of the urinary system.

Materials and Methods: A total of 186 patients participated in this study. Thirty-nine patients with chronic constipation based on Rome III criteria and 147 patients with normal bowel habits were included. All the patients were randomly divided into two groups. Patients in group 1 received castor oil before imaging and had to eat or drink nothing after midnight. Patients in group 2 were allowed to eat and drink before the examination and received no bowel preparation. Kidney-ureter-bladder radiographies were obtained in all the patients and IVUs were indicated in 77 patients. To assess the image quality, radiographic images were divided into 5 anatomical regions and each region was scored from 0 to 3 based on obscurity of the images by the bowel gas or fecal residue.

Results: Mean total score for visualization of the urinary system on plain and contrast images did not differ significantly between the two groups ($P = .253$). However, patients with chronic constipation who received bowel preparation revealed a significantly better visualization score on plain images ($P = .001$).

Conclusion: Bowel preparation prior to KUB and IVU does not improve the quality of the images in patients with normal bowel habits. However, a significantly better visualization of KUB was noted among patients with chronic constipation who had received bowel preparation.

Keywords: castor oil, cathartics, radiography, urography

INTRODUCTION

Bowel preparation prior to the kidney-ureter-bladder (KUB) radiography and intravenous urography (IVU) is routinely administered in many radiologic centers to improve the image quality and visibility of the urinary tract details. Fluid and food restriction and bowel preparation have been considered to reduce overlying bowel gas and feces that may obscure details on the image. Functional constipation may also increase bowel gas and fecal residue and impair the quality of images.

Despite the growing evidence questioning the rationale for bowel preparation before IVU,[1-9] the efficacy of laxatives administration before IVU has not been studied in patients suffering from functional constipation.

We conducted this prospective randomized trial to assess whether bowel preparation prior to KUB and IVU improves significantly visualization of the urinary system in patients with normal bowel habits and those with chronic constipation.

MATERIALS AND METHODS

The study comprised a total of 186 patients who have been prescribed KUB or IVU. Patients with renal insufficiency, bowel stoma, previous colon surgery, and any potential contraindication to laxatives administration were excluded from the study. Informed written consent was obtained from each patient prior to inclusion and the local medical ethics committee approved the study protocol.

Thirty-nine patients with chronic constipation based on Rome III criteria[10] and 147 patients with normal bowel habits were included. Rome III diagnostic criteria for functional constipation are listed in Table 1. All the patients were randomly divided into two groups. Patients in group 1 were instructed to drink 80 mL of castor oil at 7 pm after the meal in the evening before IVU and had to eat or drink nothing after midnight. Patients in group 2 were allowed to eat and drink before the examination and received no bowel preparation.

Initially, a plain film of the abdomen (KUB) was obtained from all the patients. Thereafter, a contrast agent (Iodixanol, 1 mL/kg) was administered intravenously in 77 patients. The decision to perform IVU was based on urological indications.

To assess the image quality, radiographic images were divided into 5 anatomical regions, including the right renal, left renal, right ureteral, left ureteral, and pelvic regions, and the following grading system was created: if more than two-thirds of a specific anatomical section was obscured by fecal residue or bowel gas, the score was 0; if residue or bowel gas was seen in less than two-thirds, but more than one-third of a specific anatomical region, the score was 1; if residue or gas was seen in less than one-third of a specific anatomical region, the score was 2; and if the specified section was fully visualized, the score was 3. Therefore, the maximum score for an image was 15.

In addition to the aforesaid grading system, we used the European Commission Guidelines for evaluation of image quality in this study (Table 2).[11] A fulfilled criterion was scored as 1 and non-fulfilled as 0. All images were scored by a urologist who did not know to which group each patient belonged to.

General and clinical patients' characteristics, including gender, age, and body mass index (BMI) were recorded. Before

Table 1. Rome III diagnostic criteria for functional constipation.*

1. Must include two or more of the followings:
Straining during at least 25% of defecations
Lumpy or hard stools in at least 25% of defecations
Sensation of incomplete evacuation for at least 25% of defecations
Sensation of anorectal obstruction or blockage for at least 25% of defecations
Manual maneuvers to facilitate at least 25% of defecations (eg, digital evacuation, support of the pelvic floor)
Fewer than three defecations per week
2. Loose stools are rarely present without the use of laxatives
3. Insufficient criteria for irritable bowel syndrome

*Criteria fulfilled for the last 3 months with symptom onset at least 6 months prior to diagnosis.

examination, patients were asked to report any side effect that they had experienced from bowel preparation. They were also asked to report their attitude toward the preparation method as not unpleasant, unpleasant, or very unpleasant. Statistical analysis was performed using SPSS software (the Statistical Package for the Social Sciences, Version 17.0, SPSS Inc, Chicago, Illinois, USA).

RESULTS

Table 3 shows the patients' characteristics. No significant difference was noted between the groups in terms of gender, age, and BMI. Patients with chronic constipation were equally divided between the two groups.

Plain images were obtained in 186 patients, of which 91 received bowel preparation. Mean total score for visualization of the urinary system on plain images was 12.04 ± 1.91 and 12.36 ± 1.62 for groups 1 and 2, respectively, and the difference was not statistically significant (P = .253, Mann-Whitney U test). Using European Commission Guidelines for evaluation of image quality, we noted no significant difference between the groups (3.60 ± 0.66 versus 3.70 ± 0.62 in patients with and without preparation, respectively, P = .101, Mann-Whitney U test).

Among 39 patients with chronic constipation, 17 received castor oil and revealed a significantly better visualization score on plain images in comparison with the remaining 22 patients, who received no preparation prior to KUB (Table 4).

Contrast images were obtained in 77 of 186 participating subjects. Mean total score for visualization of the urinary system on contrast images was 13.00 ± 1.31 and 12.71 ± 1.25 for groups 1 and 2, respectively, and the difference was not statistically significant (P = .694, Mann-Whitney U test). Comparing visualization scores in this subgroup of patients based on European Commission Guidelines revealed no statistically significant difference between the two groups (4.38 ± 0.52 versus 4.14 ± 0.38 for groups 1 and 2, respectively, P = .463, Mann-Whitney U test). In contrast to plain images, bowel preparation did not increase the quality of the contrast images in patients with constipation (Table 5).

Based on BMI, patients were divided into two categories: BMI ≤ 25 and BMI > 25. Although the constipation was more prevalent among patients with BMI > 25 (34.7% versus 16.1%, P = .006), no significant difference was noted in image quality between the two categories.

Of 91 patients who had received castor oil, moderate or severe abdominal pain occurred in 21 (23.1%), nausea in 9 (9.9%), and vomiting in 4 (4.4%) patients. Thirty-seven (40.6%) patients reported the effects of castor oil as unpleasant and 15 (16.5%) as very unpleasant.

DISCUSSION

In this study, plain abdominal film without administration of contrast media was obtained in 109 patients who were suspicious for ureteral stone. The overall quality of images was poor irrespective of receiving bowel preparation. Kidney-ureter-bladder radiography in evaluation of the ureteral and kidney stones has widely been replaced with unenhanced computed tomography (CT) as a useful imaging technique, especially in patients presenting with acute flank pain.[12]

Table 2. European Commission Guidelines for evaluation of image quality.

	Image criteria before administration of contrast medium
Criterion 1	Reproduction of the area of the whole urinary tract from the upper pole of the kidney to the base of the bladder
Criterion 2	Reproduction of the kidney outlines
Criterion 3	Visualization of the psoas outlines
Criterion 4	Visually sharp reproduction of the bones
	Image criteria after administration of contrast agent
Criterion 1	Increase in parenchymal density (nephrographic effect)
Criterion 2	Visually sharp reproduction of the renal pelvis and calyces (pyelographic effect)
Criterion 3	Reproduction of the ureteropelvic junction
Criterion 4	Visualization of the area normally traversed by the ureter
Criterion 5	Reproduction of the whole bladder area

Table 3. Patients' characteristics.

Gender, n (%)			
Male	60 (65.9)	61 (64.2)	.805*
Female	31 (34.1)	34 (35.8)	
Constipation, n (%)			
Yes	17 (18.7)	22 (23.2)	.453†
No	74 (81.3)	73 (76.8)	
Mean age, y	42.2 ± 14.8	42.0 ± 14.0	.937‡
Mean body mass index, kg/m^2	23.9 ± 2.9	23.6 ± 2.8	.496‡

*Chi-Square test
† *t* test

Computed tomography urography, a multiphasic CT scanning technique, is becoming more common in investigation of the urinary system, and the available data indicate that CT urography has a high diagnostic accuracy and may simplify some diagnostic algorithms. However, comparative studies on the diagnostic accuracy of CT urography and IVU are lacking.[13] Higher radiation dose of CT urography in comparison with IVU (20 to 30 mSv versus 5 mSv) has limited widespread use of this technique and IVU is still frequently performed in many radiologic centers.

Although there is no consensus on the need for bowel preparation prior to IVU, most urologists and radiologists recommend some forms of catharsis prior to IVU in order to improve the diagnostic quality of the image. A survey at departments of radiography in the West Midlands, United Kingdom revealed that a kind of bowel preparations was administered at 14 of 15 departments.[2] Schuster and colleagues in a similar survey at 121 hospitals in Illinois showed that only one department did not use bowel preparations.[5]

Bowel preparation is a time-honored procedure and is associated with adverse effects, such as abdominal pain, nausea, vomiting, and fluid and electrolyte depletion. Roberge-Wade and associates reported moderate or severe side effects in 97% of patients who received castor oil prior to IVU.[1] In the study of Bailey and coworkers, 40% of patients found the effects of the laxatives to be unpleasant or very unpleasant.[2] Excessive purgation also has been associated with the risk of fecal peritonitis.[14] Therefore, the side effects of bowel preparation are common and can be especially devastating for bedridden and elderly patients.

Neither bowel preparation nor dietary restriction was associated with higher visualization scores of the images in our study, and administration of laxative was associated with a high incidence of adverse effects and discomfort. We found that bowel preparation may only function with helping visualize the urinary system on the plain image in patients with chronic constipation. Few patients with constipation underwent IVU in this study; therefore, the power of study is not sufficient to evaluate the effect of bowel preparation on contrast images in this subgroup of patients.

The safety and efficacy of bowel preparation have been addressed previously in several clinical trials.[1-9] They concluded that food and fluid restriction have no advantage regarding better image quality. Bowel preparation may slightly decrease the fecal residue at the expense of patient discomfort.[3,8]

Interestingly, some authors believe that use of laxatives may create excessive gas that compromises the image quality and diagnostic accuracy.[6] Guo and colleagues selected 3 laxatives to determine whether routine bowel preparations are necessary for satisfactory visualization of the urinary system

Table 4. Comparing the quality of plain images in prepared and unprepared subjects considering their bowel habit patterns.

	Number of patients	Visualization score	*P*	Image quality based on European Commission Guidelines	*P*
Patients with constipation					
Group 1	17	11.53 ± 2.40	.001	3.47 ± 0.87	.005
Group 2	22	8.81 ± 2.32		2.54 ± 0.80	
Patients with normal bowel habits					
Group 1	74	12.04 ± 1.91	.253	3.60 ± 0.66	.101
Group 2	73	12.36 ± 1.62		3.70 ± 0.62	

during IVU. Groups who had received Senna, magnesium sulfate, and polyethylene glycol were compared with each other and with unprepared group. Although patients in the Polyethylene glycol and Senna groups had lower fecal residue scores, there were no significant differences in the visualization or overall quality scores of images between the prepared and unprepared groups. Comparing the scores of each anatomical section in control images, Guo and associates noted a higher visualization score of the right renal region in the Senna group in comparison with unprepared patients, and suggested that bowel preparation may only increase the visualization score of the right renal region on the control image.[8]

Using European Commission Guidelines, Jansson and coworkers showed that fulfillment of the image quality criteria was equivalent in the three different preparation groups, including polyethylene glycol, dietary restriction, and no preparation at all. They noted an equal amount of gas in the patients who had received polyethylene glycol and other two preparation groups. They found that in patients with poor kidney outlines, contrast medium administration significantly improves the visibility of the kidney outlines.[9]

Dehydration has been considered to provide greater concentration of contrast and better visualization of the collecting system.[15] Sherwood and colleagues recommended 8 to 12 h dehydration in their study and showed that overhydration has been associated with a lower image quality.[16] However, subsequent studies have failed to advocate their findings and several studies have shown that the quality of IVUs might not be improved with dehydration.[17-19]

Dure-Smith found no significant improvement in visualization of the urinary collecting system despite fluid restriction, and noted that active hydration may even produce a diagnostic quality urogram.[19] Although the nephrotoxicity of low-osmolar radiographic contrast media is low, fluid restriction may increase the risk of contrast-induced nephropathy, especially in diabetic patients.[20,21] The Royal College of Radiologists (2005) does state that dehydration prior to contrast agent administration should be avoided to reduce the risk of contrast-induced nephropathy.[22]

Some trials have excluded patients older than 70 years who may suffer from constipation due to medication or immobility.[8] Patients in this group may require bowel preparation before IVU. The value of bowel preparation in patients with chronic constipation has not been evaluated previously. To the best of our knowledge, our study is the first trial in which the value of laxatives administration prior to KUB and IVU has been evaluated in patients suffering from functional constipation.

CONCLUSION

Preparation and fluid and dietary restrictions prior to IVU stem from historical reports and do not seem to be evidence-based practices. Type and amount of contrast agents, the radiographic equipments, and the availability of tomography also affect the visualization of the urinary tract. Today's contrast agents lack an osmotic effect (with an osmolality of 290 mOsm, the same as blood) or have a low osmotic effect, and theoretically, are not associated with increased diuresis and decreased contrast enhancement. Considering the better quality of non-ionic contrast, the larger volumes used, and advances in radiographic equipment and technique, the routine use of catharsis and dietary restrictions before urography is no longer justified, especially in patients with normal bowel habits.

Table 5. Comparing the quality of contrast images in prepared and unprepared subjects considering their bowel habit patterns.

	Number of patients	Visualization score	*P*	Image quality based on European Commission Guidelines	*P*
Patients with constipation					
Group 1	8	13.00 ± 1.31	.694	4.38 ± 0.52	.463
Group 2	7	12.71 ± 1.25		4.14 ± 0.38	
Patients with normal bowel habits					
Group 1	35	13.26 ± 1.31	.282	4.29 ± 0.46	.443
Group 2	27	12.93 ± 1.17		4.37 ± 0.56	

CONFLICT OF INTEREST

None declared.

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