

**Original article**

**Bowel preparation in intravenous urography doesn't have an impact on the quality of urinary tract image**

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**Abstract:**

**Purpose:** The procedure of bowel preparation before intravenous urography (IVU) is still a controversial debate and it varies in each health center. Preparation is believed to reduce residual feces and intestinal gas thus improving the quality of visualization of the urinary tract. On the other hand, many radiology and urology studies did not mention the need for preparation before IVU procedure. Preparation before IVU, especially giving laxative agent, gives many adverse effects to the patient. The purpose of this study was to know the difference in quality visualization of the urinary tract in IVU patients with and without preparation in Saiful Anwar hospital Malang. **Materials and Methods:** A total of 20 patients participated in this study and they were divided into two groups in which each group consists of 10 patients with and without preparation before IVU. Abdominal x-ray and IVU were performed on all patients. Urinary tract visualization quality assessment was done through two methods of assessing the quality of the image by the European Commission Guidelines and of assessing the residue of feces/intestinal gas based on Dadkhah's studies. **Results:** Results showed the total score of image quality and the residue of feces/intestinal gas was not significantly different in the abdominal plain photo of IVU patients with and without preparation (Mann-Whitney test (p=1.000) and Independent T-test (p=0.5111)). **Conclusions:** In conclusion, there was no difference in the quality of visualization of the urinary tract in IVU patients with and without preparation in Saiful Anwar hospital Malang.

**Keywords:** Bowel preparation; Image quality; IVU

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**Introduction:**

For decades, intravenous urography (IVU) is the primary modality for evaluating abnormalities of the urinary tract. There is also development of other radiological examinations such as ultrasonography (USG), Computed Tomography (CT) or Magnetic Resonance Imaging (MRI), and the frequency of using these modalities has increased to compensate for the limitations of IVU<sup>1-3</sup>. However, the investigation also has limitation in assessing abnormalities in the urinary tract so that IVU still has an important role in the diagnosis of urinary tract diseases<sup>4-6</sup>. The number of IVU examination at the Saiful Anwar hospital Malang reaches an average of about 125 cases per month, or about 1500 cases per year.

Preparation before IVU examination procedures is still a controversial debate. Application of the preparation procedure on a patient prior to IVU examination varies in fasting condition, laxative agent use and diet. Preparation procedure is believed to be able to improve the quality of images in the visualization of anatomical and pathological urinary tract. On the other hand, there are many radiology and urology studies do not mention the need for preparation before IVU procedure. Research by Dadkhah et al (2012) obtained no significant difference in image quality on plain abdominal or IVU between patient groups compared with the group without preparation before IVU examination in patients without defecation disorders<sup>7</sup>. Whereas in

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patients with chronic constipation, the image quality was significantly improved in patients administered laxative agent. Another study by Guo et al (2006) reported that the preparation did not improve image quality on plain abdominal and IVU <sup>8</sup>.

Preparation before IVU especially giving laxative agent, has side effects on a patients such as discomfort in the abdomen, the full sense of the abdomen, nausea, vomiting, feeling weak, thirst, diarrhea, decreased body fluids and electrolyte, and even insomnia <sup>1,4,9</sup>. Bailey et al (1991) mentioned that about 40% of patients experienced a sense of discomfort after the administration of laxative agent. Even other studies state that giving too much laxative agent can lead to the risk of fecal peritonitis <sup>1,4,10</sup>.

Because there are many side effects during the preparation before IVU, then we need to review the necessity of preparation especially laxative agent administration. Therefore, the researchers wanted to know whether there was difference in the quality of visualization of the urinary tract in IVU patients with and without preparations a basis for policy studies in Saiful Anwar hospital Malang.

**Materials and methods:**

This study was approved by the Ethics Committee of Faculty of Medicine, Brawijaya University, Malang - Indonesia.

A quasi-experimental design conducted in Department of Radiology, Saiful Anwar hospital Malang in the period of December 2014 to January 2015. The materials used are made from non-ionic iodine contrast media dose of 1cc/kg of body weight, In addition, the equipment used are the X-ray ToshibaBLR-1000A and Fujifilm 4000 pixcleaning FCRXLII capsule.

The subjects of this study are patients underwent IVU who fulfill both the inclusion and exclusion criteria. The inclusion criteria include patients underwent IVU with suspected clinical diagnosis urolithiasis, willing to participate in the study (filling informed consent) and adult patients (aged over 18 years). Exclusion criteria include patients with functional constipation according to Rome III criteria and the result of IVU showed non-visualized kidney. In this study there is 1 control group and 1 experimental group, the sample size obtained is 10 patients per group. So overall sample size is 20 patients.

This study uses two types of assessment, namely the assessment of the IVU image quality based on the European Commission Guidelines and the

assessment of residual feces/intestinal gas based on study conducted by Dadkhah et al <sup>7</sup>.

**IVU image quality assessment based on the European Commission Guidelines<sup>11</sup>.**

The assessment is determined by a scoring system in which if it meets the criteria it was given a score of 1 (one) and do not meet the criteria given a value of 0 (zero) on each criterion. Three radiologists conducted the assessment, where the score used is the same score assessed by at least two examiners.

**Table 1. European Commission Guidelines for evaluation of the 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	Visualization 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 transverse by the ureter
Criterion 5	Reproduction of the whole bladder area

**2. Residues Assessment feces/intestinal air gas based on studies by Dadkhah <sup>7</sup>.**

Assessment conducted on plain abdominal region on IVU in 5 anatomical regions namely the right kidney, left kidney, right ureter, the left ureter, and pelvic. Each region was assessed with a score of 0 to 3 and then summed. Three radiologists conducted the assessment, where the score used is the same score assessed by at least two examiners.

**Table 2. Assessment criteria on residual feces or gas in the intestine based on studies by Dadkhah et al**

Score	Criterion
0	There are >2/3 residue of feces or intestinal gas in one region
1	There are >1/3 - 2/3 residue of feces or intestinal gas in one region
2	There are < 1/3 residue of feces or intestinal gas in one region
3	There is no residue of feces or intestinal gas in one region

Data analysis was conducted by:

- a. The results followed a normal distribution of data with independent T-test
- b. The results of the data are not normally distributed Mann-Whitney test was continued with a 95% confidence level,  $\alpha$  0.05, significant when  $p < 0.05$

**Results:**

Within 2 months (December 2013 to January 2014), there were 20 obtained samples of studies that met the inclusion and exclusion criteria and divided into 2 groups, consisting 10 patients respectively with preparation and no preparation before IVU examination. The sample consists of men and women, aged 19 to 66 years. The entire examination was done in Department of Radiology, Saiful Anwar hospital Malang.

Distribution of the sample according to age characteristics can be seen in the following graph:

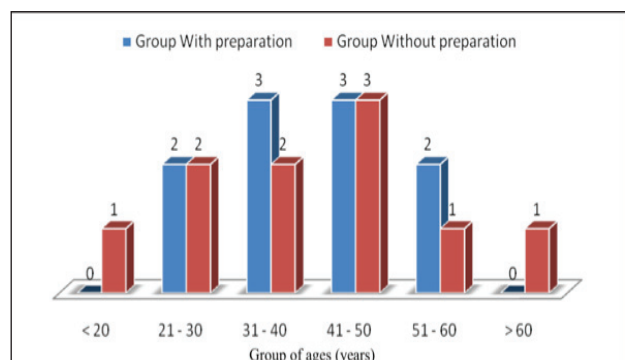


Figure1. Graph distribution of the sample according to the characteristic of age

The above graph shows that the highest age of the study sample aged 31-50 years.

Distribution of the sample by gender is as follows:

**Table 3. Sex distribution of samples**

Sex	With preparation (n,%)	Without preparation (n,%)	Total (n,%)
Male	6 (60%)	7 (70%)	13 (65%)
Female	4 (40%)	3 (30%)	7 (35%)

Table shows that the number of male sample is greater than that of female both in the group with or without preparation, respectively 6 patients (60%) and 7 patients (70%).

**IVU Image Quality Assessment Based on the European Commission Guidelines<sup>7,10,11</sup>**

Distribution IVU image quality score is based on the European Commission Guidelines to the patient with preparation as shown in the following table:

**Table 4. Distribution IVU Image Quality Score Based on the European Commission Guidelines on Patients with Preparation**

Patient's number	Assessment criteria										Total score
	Before contrast					After contrast					
	1	2	3	4	1	2	3	4	5		
1	1	1	1	1	1	1	1	1	1	1	9
2	1	0	1	1	1	1	1	1	1	1	8
3	1	1	1	1	1	1	1	1	1	1	9
4	1	1	1	1	1	1	1	1	1	1	9
5	1	1	1	1	1	1	1	1	1	1	9
6	1	1	1	1	1	1	1	1	1	1	9
7	1	1	1	1	1	1	1	1	1	1	9
8	1	1	1	1	1	1	1	1	1	1	9
9	1	1	1	1	1	1	1	1	1	1	9
10	1	1	1	1	1	1	1	1	1	1	9

Distribution IVU image quality score is based on the European Commission Guidelines to the patient without preparation as shown in the following table:

**Table 5. Distribution IVU Image Quality Score Based on the European Commission Guidelines on Patients without Preparation**

Patient's number	Assessment criteria										Total score
	Before contrast					After contrast					
	1	2	3	4	5	1	2	3	4	5	
1	1	1	1	1	1	1	1	1	1	1	9
2	1	1	1	1	1	1	1	1	1	1	9
3	1	1	1	1	1	1	1	1	1	1	9
4	1	1	1	1	1	1	1	1	1	1	9
5	1	1	1	1	1	1	1	1	1	1	9
6	1	1	1	1	1	1	1	1	1	1	9
7	1	1	1	1	1	1	1	1	1	1	9
8	1	1	1	1	1	1	1	0	1	1	8
9	1	1	1	1	1	1	1	1	1	1	9
10	1	1	1	1	1	1	1	1	1	1	9

Tables 4 and 5 show that in each of the 10 samples of patients with and without preparation, there were 9 (90%) samples had a score of 9, and only 1 (10%) sample had a score of 8.

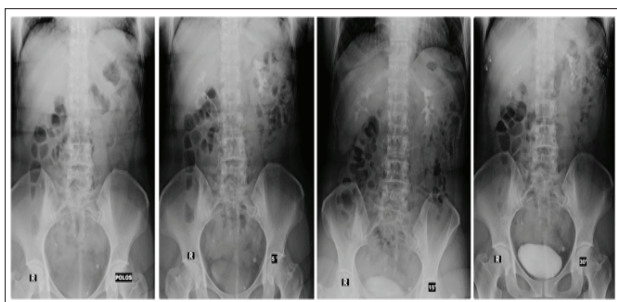


Figure 2. Serial IVU photo (plain photo, 5 minutes, 15 minutes, 30 minutes) in one patient with preparation (patient code AR-3) with a total score of 8 based on European Commission Guidelines. In plain photo, the limit between right and left kidneys cannot be seen, so that criterion 2 precontrast that is the visualization of renal limits is not met. Other assessment criteria are met.

**Assessment residue Feces/Gas intestine based on a study by Dadkhah**

Distribution of residual feces scores/intestinal gas based on studies by Dadkhah in patients with preparations as shown in the following table:

**Table 6. Distribution of the Score Residual Feces/Intestinal Gas Based on a Study by Dadkhah in Patients with Preparations**

Patient's number	Region					Total score
	Right kidney	Left kidney	Right Ureter	Left Ureter	Pelvic	
1	1	2	2	2	3	10
2	0	2	2	1	2	7
3	1	1	2	2	2	8
4	1	2	2	2	2	9
5	2	1	2	1	2	8
6	2	2	2	2	2	10
7	2	2	2	2	2	10
8	2	2	2	2	2	10
9	1	2	2	2	1	8
10	1	2	1	1	3	8

Distribution of residual feces scores/gas based on studies by Dadkhah in patients without preparations are shown in the following table:

**Table 7. Distribution of the Score Residual Feces/Intestinal Gas Based on a Study by Dadkhah in Patients without Preparations**

Patient's number	Region					Total score
	Right kidney	Left kidney	Right Ureter	Left Ureter	Pelvic	
1	1	1	1	2	3	8
2	2	2	2	2	1	9
3	1	0	1	2	2	6
4	1	1	1	2	2	7
5	1	2	2	2	2	9
6	2	2	2	3	2	11
7	2	2	1	2	3	10
8	1	2	1	2	1	7
9	0	2	2	3	2	9
10	1	1	2	2	2	8

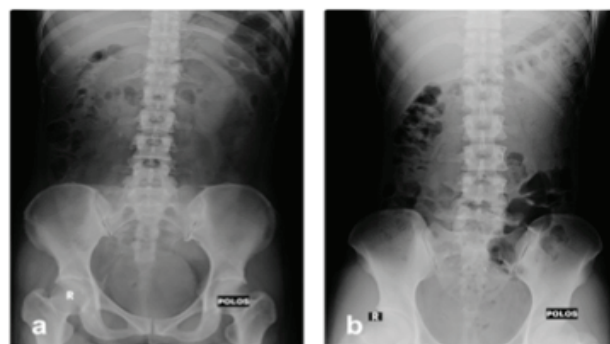


Figure 3. Plain photo Example of abdominal of the patient with preparation.



Assessment criteria based on studies of Dadkhah on 5 anatomical regions of the patient code AR-2 (a) that the right kidney region (score 1), left kidney (2), right ureter (2), left ureter (2), pelvic (3), so the total score is 10. Patient code AR-4 (b), i.e. the region of the right kidney (0), left kidney (2), right ureter (2), left ureter (1), pelvic (2), so that the total score is 7.

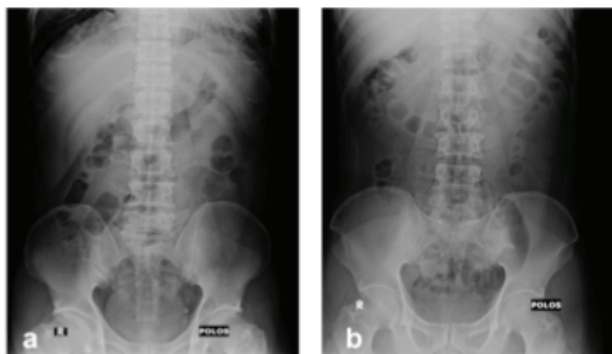


Figure 4. Plain photo Example of abdominal of the patient without preparation.

Assessment criteria based on studies of Dadkhah on 5 anatomical regions of the patient code AR-1 (a) that the right kidney region (score 1), left kidney (1), right ureter (1), left ureter (2), pelvic (3), so the total score is 8. Patient code AR-3 (b), i.e. the region of the right kidney (2), left kidney (2), right ureter (2), left ureter (2), pelvic (1), so that the total score is 9.

**Inter-variable Relationship**

**1. Relationship between IVU Image Quality Score Based on the European Commission Guidelines in Patients with and without Preparation**

Difference test using the Mann-Whitney test to look at the relationship between IVU image quality score in patients with and without preparation obtained the following results:

**Table 8. Relationship between IVU Image Quality Score Based on the European Commission Guidelines in Patients with and without Preparation**

Group	Number of Patients	Mean Rank	P
With preparation	10	10.50	1.000
Without preparation	10	10.50	

The test results showed a significant value (p) of 1.000 is greater than  $\alpha=0.05$ , so that it can be concluded that there was no difference in IVU image quality obtained in patients with and without preparation.

**2. Relationship between the Score Residual Feces/Intestinal Gas Based on a Study by Dhadhkhah in Patients with and without Preparation**

Different test using independent t-test to see the relationship between the score of residual feces/gas intestine in patients with and without preparation obtained the following results:

**Table 9. Relationship between the Score of Residual Feces/Intestinal Gas Based on a Study by Dhadhkhah in Patients with and without Preparation**

Group	Number of patients	Score (Mean $\pm$ SD)	P
With preparation	10	8.40 $\pm$ 1,506	0.511
Without preparation	10	8.80 $\pm$ 1.135	

The test results showed a significant value (p) of 0.511 is greater than  $\alpha=0.05$ , so that it can be concluded that there was no difference in fecal residue/intestine gas based on a study by Dadkhah in patients with and without preparation.

**Discussion:**

From the sample of this study which was 20 patients with a clinical diagnosis of suspected urolithiasis with the age ranges from 31 to 50 years, there were 15 patients (75%) with the highest proportion of male (65%). This is in line with the literature stating that the age group of most patients with urolithiasis in western countries is 20-50 years, while in Indonesia, according to Purnomo (2011) ranges in ages 30-50 years. The exact cause is unknown, however, it is likely due to differences in socioeconomic factors, geography, climate and weather, culture/customs and diet <sup>4,12</sup>.

This study uses two types of assessments, which evaluate the quality of the picture on the IVU based on the European Commission Guidelines and assess residual feces/intestinal gas based on studies by Dadkhah et al (2012) <sup>7,11</sup>. In 1996, European Commission Guidelines made the criteria of image quality radiographs to provide standardization and minimize subjectivity readings. On this basis, this study employs the European Commission Guidelines score criteria as IVU image quality evaluation standard in visualizing the urinary tract <sup>11</sup>.

The results of the study for image quality assessment

by the European Commission Guidelines indicate no difference in IVU picture quality in patients with and without preparation. Factors that can affect this possibility are the use of contrast material and the use of X-Ray with Computed Radiography (CR) <sup>8,13</sup>.

- a. This study used a non-ionic iodine contrast material. Theoretically, a widely used ionic contrast used in previous studies has osmotic effects and high viscosity that can lead to increased diuresis and less effective effect on the urinary tract. The high viscosity of ionic contrast prevent contrast coating on the mucosal surface of the urinary tract, causing lack of good visualization of the urinary tract. Visualization of the collecting system can be improved with the use of modern contrast material, non-ionic, that diuresis effect is low. The characteristics of non-ionic iodine contrast material are having a high concentration of iodine, soluble in water, minimum viscosity, low osmotic pressure, do not undergo metabolic degradation, low affinity for proteins and is heat stable. Another advantage of non-ionic contrast material is the risk of nephrotoxicity is lower <sup>14,15</sup>.
- b. This study used CR that is the X-Ray BLR-1000A Toshiba and Fuji Film 4000 pix cleaning FCR XLII capsule. CR has the advantage of visualizing the radiological picture than conventional radiography because there are software tools that can enhance the image quality. CR is a form of digital images so that the resulting primary image can be manipulated to suppress the varied features to visualize structures more specific <sup>16</sup>.

The results of the study to assess the residual feces/intestinal gas based on studies by Dadkhah et al showed no difference in residual feces/intestinal gas in patients with and without preparation, however, the total quantity scores showed results which are not considered optimal because the maximum score is 15. The factors that could affect the occurrence of this possibility are related to the provisions of the preparation procedure on the patient. The condition of preparation procedures on patients is a limitation in this study because all patients are outpatient status so that researchers cannot supervise the preparation of the patient. These conditions allow for errors in the application of the provisions regarding the preparation of fasting, the use of laxative agent, and

diet <sup>2,17</sup>.

- a. In accordance with the operating procedure in Saiful Anwar Public Hospital, patients were told to fast for at least 8 hours. Fasting is associated with conditions where dehydration can decrease Glomerular Filtration Rate (GFR) and renal blood flow that can result in exposure contrast to the elongated tubular so that it will boost the risk nephrotoxic. A nephropathy circumstance causing the absorption contrast is reduced and consequently the visualization of the urinary tract becomes worse <sup>14</sup>.
- b. The use of laxative agent in the preparation procedure gives many adverse side effects to the patient so that errors may still occur against existing provisions. As a result, for the purpose of emptying the intestinal gas, laxative agent is not optimal <sup>18</sup>.
- c. Diet provisions applied to the patient with preparation cannot be monitored so that there May be an error in the application. As a result, the purpose of the diet to make the food easily digested by the intestine and the feces is not hard is not optimal.

#### **Limitations in this study:**

- a. The entire sample was patients with outpatient status, making it difficult for the researchers to supervise the patient to comply with the preparation procedures before IVU examination. This can lead to a bias in this study. To reduce the errors of the preparation procedure, then a checklist of the preparation procedure is given to the patient's family to monitor the preparations made by the patient.
- b. The presence of residual feces/intestinal gas is still quite a lot both in the group of patients with and without preparation in this study. This allows urinary tract stones with semi-opaque or radiolucent density may not be visualized because it is covered by picture residual feces/intestinal gas so that it can reduce the diagnostic value of plain radiography of the abdomen and IVU.
- c. This study used Computed Radiography (CR) is the X-Ray BLR-1000A Toshiba and Fuji Film 4000 pix cleaning FCR XLII capsule. CR has the advantage of visualizing the radiological picture than conventional radiography because there are

software tools that can improve the quality of the image so that the results of this study cannot be used as a reference as a basic policy regarding the provision of preparation procedures before IVU in health centers which are still using a conventional radiography.

**Conclusion:**

In conclusion, there was no difference in the quality of visualization of the urinary tract in IVU in patients

with and without bowel preparation at Saiful Anwar hospital Malang.

**Conflict of interest:**

The authors declare that there is no conflict of interests regarding the publication of this paper.

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