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ANALYSIS OF NON-CONTRAST CT UROGRAPHY IMAGE INFORMATION USING WATERMELON JUICE AS A DIURETIC AGENT

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KEYWORDS	ABSTRACT
ct urography, diuretics, watermelon, image information.	This research aims to determine the difference in image results between giving watermelon juice and water as a natural diuretic in producing good image performance. The method used in this research was a true experiment with a posttest-only control group design. There are two groups determined through randomization by taking cards that have been numbered according to arrival. Odd card numbers in the control group were given water, and even card numbers in the treatment group were given watermelon juice; scanning was carried out after 60 minutes. Assessment of distension using measuring distance software, enhancement by measuring the Region of Interest and assessment of artefacts and anatomical information using a questionnaire. Data processing and analysis uses the Mann-Whitney test. The research showed that using watermelon juice as a diuretic in non-contrast CT urography examinations increased distension of the pelvic pelvis and bladder. in non-contrast, in the ureters, it did not. The p-value of distension of the pelvic rents was 0.003, ureter 0.345 and bladder 0.036. It does not cause enhancement in the pelvis, ureters and bladder; the p-value of the pelvis is 0.599, the ureter is 0.294, and the bladder is 0.345. It does not cause artefacts in the pelvis, ureters and bladder. The p-value of the pelvis is 1.000, the ureter is 0.680, and the bladder is 0.511. Moreover, produces the same anatomical information; the p-value is 1,000. This study concludes watermelon juice as a natural diuretic provides superior imaging performance in pelvic and bladder distension compared to water.

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INTRODUCTION

CT urography is a diagnostic imaging method specifically designed to comprehensively assess the function of the upper urinary tract (kidneys and ureters) and bladder, including specific disorders such as ureterolithiasis, nephrolithiasis, hematuria, including congenital kidney disorders (Zeikus et al., 2019). This examination can visualize the entire urinary tract and detect various benign and malignant disorders, including urinary tract stones (Renard-Penna et al., 2020). In addition, *CT urography* can assess the urinary tract in detail and visualize adjacent structures, as well as comprehensively assess *the abdomen* and *pelvis*, thereby increasing the accuracy and sensitivity of the examination. Currently, *CT urography examination* can replace *IVU* (*Intravenous Urography*) because it is more accurate (Noegroho & Daryanto, 2018); (Cheng et al., 2019). The diagnostic accuracy of *CT Urography* is 94.2% -99.6% higher for *upper tract urothelial carcinoma* compared to IVU 80.8-84.9% (Jinzaki et al., 2016), hydronephrosis can be detected in 20 of 61 cases on *CT urography* and 17 cases in IVU (Jana & Kumar, 2019), *CT Urography* was more sensitive in detecting pathology at 98% compared to *retrograde pyelography* at 79% and the sensitivity of CT

Urography in showing *urolithiasis* was reported to be 98-100% compared to IVU at 48% (C & Ullal, 2020).

Urolithiasis, or urinary tract stones, is a disorder that often occurs in *the urinary tract*, This disorder is ranked third highest in the field of urography, below *urocystitis* and BPH. In the world, it reaches 1-20% for several countries with a ratio of 3:1 where there are more male sufferers than female sufferers and those aged 40-50 years have the highest incidence (Noegroho & Daryanto, 2018). In the United States, 5-10% of the population is found to have this disorder; likewise, in Northern Europe and Southern Europe, it is found to be 3-6% and 6-9% (Silalahi, 2020). In Indonesia, *urolithiasis* is ranked second highest after *urocystitis* and is among the highest diseases requiring treatment by a urologist (Silalahi, 2020). In West Java Province, 19.34% of the population aged ≥15 underwent *haemodialysis* due to chronic kidney failure (Riskesdas, 2018). One of the risk factors for the formation of *urolithiasis* is the supersaturation of stone-forming minerals, which allows crystals to precipitate and form stones. Diuretics can reduce this condition to increase the excretion of sodium, potassium and chloride in the urine (Ahmed et al., 2018).

Diuretics are substances that increase urine secretion (*diuresis)* through direct action on the kidneys (Tan et al., 2015). According to Deswati (2020), the term diuretic has two meanings, the first is an increase in the volume of urine produced, and the second shows the amount of dissolved substances and water excreted. In radiology, this diuretic is used in CT urography examinations to speed up the process of *urine formation.* This large amount of urine is needed to obtain maximum distension and opacity *of the collecting system* in the excretory phase of the kidneys, ureters and bladder (Cheng et al., 2019). The bladder is best assessed when it is sufficiently filled with urine, around 200 – 500 mL and has distinct *enhancement* from the surrounding tissue (Ljungberg et al., 2021). To improve the quality of adequate filling of *the renal collection* and bladder, oral hydration and diuretics can be administered before image scanning (Sung et al., 2019); (Ljungberg et al., 2021). The diuretic substance that can be used is *furosemide* (Renard-Penna et al., 2020); (Ljungberg et al., 2021); (Sung et al., 2019) and ingredients containing natural diuretic substances such as tea (Yudha et al., 2020) and coffee (Widhyani et al., 2021); (Barghouthy et al., 2020).

According to researcher the need for diuretics in CT urography examinations is due to difficulties or even failure to track the ureters, which are small and tend to have the same structure as the intestine and *psoas muscle* (Faik et al., 2018). Diuretics are also necessary because there is still a failure to obtain sufficient distension of the renal collecting system during preoperative planning to detect the location and size of the stone (Sung et al., 2019). Based on the results of *the French Society of Genitourinary conference*, to improve image quality in the excretory phase, furosemide injection must be carried out before contrast media injection for various types of indications (Renard-Penna et al., 2020). Research shows that the use of diuretics is necessary so that the entire lumen of the urinary tract can be filled with urine produced by the kidneys so that the presence of abnormalities can be immediately identified through good visualization results of image performance (Yudha et al., 2020) . The addition of *furosemide* injection at the beginning of the examination was also used by researchers (Ljungberg et al., 2021) in his research to prevent high attenuation differences due to *contrast enhancement. Urine* with surrounding tissue. This is because the contrast agent does not mix easily with urine, so it can cause small tumours to be covered by the bladder, which expands with the contrast agent.

The benefit of giving diuretics in CT Urography is to increase the volume of urine produced so that there is an increase in distension and a decrease in density in the urinary tract, which is very helpful in the tracking process *to* produce optimal images (Faik et al., 2018). This is very helpful in evaluating kidney function in channelling *urine* from the kidneys to *the urinary bladder* and helps confirm the diagnosis of the urinary tract. Another benefit is diluting the excreted contrast medium, thereby reducing artefacts, improving visualization of the ureteral walls, and detecting filling defects (Renard-Penna et al., 2020). Researcher showed that bladder images with a larger volume and better bladder attenuation were used to detect small tumours on the bladder wall (Ljungberg et al., 2021) . Administration of diuretics will trigger hyper-diuresis minutes after injection, which accelerates opacification of the urinary tract and increases distension and visualization of the middle and distal ureters (Renard-Penna et al., 2020).

In urolithiasis patients, non-contrast CT urography is the imaging of choice performed preoperatively to assess the location, number and location of stones (Sung et al., 2019). The results of this scan are very important and necessary to plan the appropriate surgical procedure. Even though this examination is very good for evaluating stones, there are still difficulties in characterizing the renal collecting system, there are still obstacles in showing sufficient distension of the renal *collecting system*, and in Sung's research (Sung et al., 2019), giving diuretics and oral hydration regularly. Significantly increases the surface area and volume *of the renal collecting system*. Research conducted by researchers shows that giving diuretics and oral hydration can improve the quality of bladder filling with a larger volume and more appropriate attenuation (Ljungberg et al., 2021) . In cases of ureteral stones, ureteral dilatation/distension is very important in diagnosing smooth, small, non-obstructive, and low-density stones (Itanyi et al., 2020). Diuretics can increase the amount of fluid in the ureters, increasing ureteral distension. The greater the amount of water contained in the lumen of the ureter, the lower the density compared to nearby organs, thus helping to assess stones in the ureter. Providing a natural diuretic in the form of black tea can increase urine production, which will fill the entire lumen of the urinary tract, thereby causing an increase in enhancement *compared* to the surrounding organs (Yudha et al., 2020).

Sources of natural diuretic substances can be found in fruits and vegetables, which are local natural resources that are safe and have minimal side effects when used correctly (Purwidyaningrum & Billi, 2018). Watermelon, known as *Citrullus lanatus*, is cheap and easy-to-obtain fruit and is widely popular because of its refreshing taste, high water content and sweet taste in the flesh. This fruit contains many nutrients such as fibre, *lycopene*, vitamin A and potassium. The potassium in every 100 grams of watermelon flesh is 112 mg. This high potassium content plays a role as a natural diuretic (Jafar et al., 2020).

Apart from potassium, watermelon contains natural *citrulline*. The *citrulline content* is often found in ripe watermelon, and there is no significant difference in *the citrulline content* found in the flesh and skin (Joshi et al., 2019). Based on research conducted by Carleto (Corleto et al., 2019) on several types of fruit and vegetables which are sources of *citrulline,* it was found that watermelon juice had the highest *citrulline content.* (716.57±24.80 µg/mL) followed by *zucchini squash* (115.68±7.82 µg/mL), *calabaza squash* (70.99±8.16 µg/mL), cucumber (55.66±3.96 µg/mL), yellow pumpkin (46.31±1.53 µg/mL), and celery juice (11.48±2.16 µg/mL). The presence of *citrulline will increase the arginine* content, which functions to regulate nitric oxide and blood flow and plays a role in removing excess ammonia from the human body, so th*e citrulline* and *arginine* found in watermelon play a role in increasing *urine volume* (Kyriacou et al., 2018).

Produces *CT urography image performance* with *distension* and opacity. Optimizing the upper urinary tract and bladder is still challenging (Renard-Penna et al., 2020). There are still difficulties in *tracking* the image of *the ureters*, which is one of the causes of failure in the 3D reconstruction of the urinary tract on *CT urography examinations* (Faik et al., 2018). Giving 1 litre of mineral water before the examination often causes discomfort in the form of nausea and vomiting in patients, which can cause the diuretic process to fail, resulting in less *urine* produced (Sung et al., 2019). Besides that, according to researcher (2012) in Ljungberg giving 10 mg of *forusemide Intravenous* drugs, which are chemical diuretics, causes a very strong urge to urinate so that there is a risk of movement during image acquisition and has the potential to cause artefacts in the image (Ljungberg et al., 2021) . These conditions can have an unfavourable impact on the performance of the images that will be produced. The performance of images resulting from CT urography examinations plays a very important role in diagnosing and following up the treatment of urolithiasis patients. For this reason, it is necessary to implement a new protocol to provide alternative fruit-based drinks containing high water and diuretic substances and a more refreshing taste.

Apart from being easily available and having a popular taste, watermelon has a high water content and also contains high levels *of citrulline,* which functions as a diuretic. This aligns with research conducted by researchers where giving watermelon to experimental animals can significantly increase diuretic activity (Siddiqui et al., 2018) (Gul et al., 2014) . This condition can be utilized during CT Urography examinations to fulfil the oral hydration protocol and administration of diuretics. Black tea was not used in this study because researcher showed that black tea did not significantly increase the amount of urine produced by the kidneys and could not have a good influence on the resulting image (Yudha et al., 2020) . Water is not used because there are complaints about the taste being unfavourable, causing nausea or vomiting. According to the results of pre-research to explore the convenience of drinking 1 L of watermelon juice, which was carried out on February 7 2023, and February 8 2023, on 5 people where each was given 1 L of watermelon juice and 1 L of mineral water, watermelon juice was preferred/preferred than mineral water.

Based on the background above, this research aims to determine the difference in image results between giving watermelon juice and water as a natural diuretic in producing good image performance. The benefit of this research is to provide an overview of the effectiveness of administering watermelon juice during non-contrast CT urography examinations as a natural diuretic in helping to produce good image performance. To analyze the differences in image results of giving watermelon juice and water on the enhancement of the pelvis, ureters and bladder and also to analyze the differences in image results of watermelon juice with water on the artefacts produced.

Research shows the effectiveness of watermelon juice, it may provide a more natural therapeutic option for patients who want to avoid chemical drugs or have allergies to them. This research could open the door to innovations in non-contrast urography techniques, which could help improve the accuracy of diagnosis and treatment.

METHOD

This research was carried out with two groups: the control group providing 1 litre of water and the treatment group providing treatment in the form of 1 litre of pure watermelon juice. Image scans in this study were carried out after administering water and watermelon juice. Watermelon juice, with its citrulline content, will act as a natural diuretic, which is needed in CT urography to increase urine production, which is useful in increasing distension, increasing enhancement and reducing background area artefacts.

After the scanning process, image post-processing is carried out, and the image results obtained in the two groups will be analyzed objectively and subjectively. Objective assessment is done by measuring distension using Measure Distance software measuring enhancement by carrying out Region of Interests (ROI) on organs to see Hounsfield Units. Subjective assessment of artefacts is carried out using scoring and creating related questionnaires regarding anatomical information and diagnostic information that will be assessed by the respondent (Radiology Specialist).

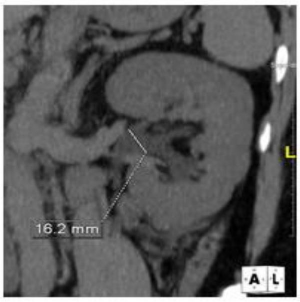
The type of research that will be carried out is the True Experiment, intending to test the performance of watermelon juice in improving image quality from the aspect of image anatomical information. The target population in this study was all CT urography patients. The population covered in this study were all CT urography patients at Gunung Jati Hospital, Cirebon, from May to

June 10 2023. The research sample was taken from the population of patients who would undergo non-contrast CT urography examinations and who met the predetermined inclusion and exclusion criteria.

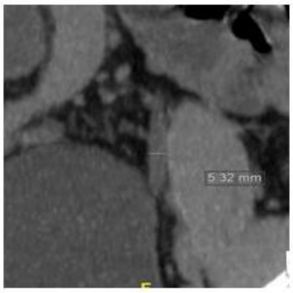
RESULTS AND DISCUSSION

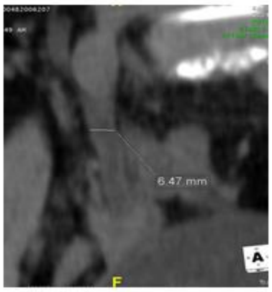
Differences in the results of giving watermelon juice compared to mineral water on distension of the urinary pelvis, ureters and bladder

Visualization of pelvic distention, ureters and bladder from images of the control and treatment groups is shown in Figure 1



1(a). **1(b.)**





2(a) **2(b)**


3(a) **3(b)**

Figure 1. Visualization of Distension of Control and Treatment Groups 1(a) Control Renis Pelvis, 1(b) Treatment Renis Pelvis, 2(a) Control Ureter 2(b) Treatment Ureter and 3(a) Control Bladder 3(b) Control Bladder Urinary Treatment

Figure 1 shows that the difference in image distension between the control and treatment groups in the pelvis of the control group was 16.2 mm, and the treatment group was 21.8 mm. Ureteral distension in the control group was 5.32mm, and in the treatment group 6.47mm. Bladder distension in the control group was 84.2 mm, and in the treatment group, 92.5 mm.

The results of pelvic, ureteral and bladder distension measurements in the control and treatment groups are shown in Table 1.

Table 1. Results of distension measurements for the control group and treatment group

Object	No. Image	Distension Water Group	Distension of Watermelon Clusters
Renis Pelvis	1	16.1	16.3
	2	8.0	13.8
	3	13.3	14.1
	4	9.3	17.1
	5	11.2	18.7
	6	4.8	14.7
	7	11.6	14.2
	8	13.2	22.2
Ureter	1	5.4	16.4
	2	2.9	9.3
	3	7.6	7.8
	4	9.8	5.1
	5	5.0	3.5
	6	2.6	4.6
	7	5.3	8.0
	8	7.3	6.7
Bladder	1	84.0	65.4
	2	66.9	99.1
	3	85.5	91.0
	4	70.8	90.4
	5	83.8	90.6
	6	88.4	98.2
	7	80.1	97.3
	8	96.2	92.6

Table 1 shows that the pelvic distension of the treatment group images has higher distension than the control group. The ureteral distension of the treatment group images in most images had higher distension than that of the control group. Most images of the treated group's bladder distension were higher than those in the control group.

a. Normality Test and Image Distension Difference Test for Control and Treatment Groups

The normality test for distension data in this study used Shapiro Wilk because the sample size was < 50, and the results are shown in Table 2.

Table 2. Distension Normality Test Results

Distension	p-value	Information
Control	0,000	Not normally distributed
Treatment	0,000	Not normally distributed

*Shapiro-Wilk

Table 2 shows that the image distension data for the control and treatment groups has a p-value of 0.000, namely <0.05, meaning the data is not normally distributed, so the Mann-Whitney test was carried out. The results are shown in Table 3.

Table 3. Differences in Pelvic Distention, Ureter and Bladder Urinary Control Group and Treatment Group

	Organ	Control *Mean* ± SD	Treatment *Mean* ± SD	*p-value*	Information
Distension	**Renis Pelvis**	10.94 ± 3.52	16.39 ± 2.90	0.003	There's a difference.
	Ureter	5.73 ± 2.42	7.68±4.02	0.345	There's no difference.
	Bladder	81.96±9.40	90.58±10.78	0.036	There's a difference

*Mann Whitney

Based on Table 3, information is obtained that the distension in the pelvis of the control group obtained a mean ± SD of 10.93 ± 3.52 and the treatment group 16.39 ± 2.90 with a p-value of 0.003, namely < 0.05, which means there is a difference in distension. Renal pelvis in both the control and treatment groups. Distension in the ureter of the control group obtained a mean ± SD of 5.73 ± 2.42 and the treatment group 7.68 ± 4.02 with a p-value of 0.345, namely > 0.05, which means there is no difference in ureteral distension in both the control group and the treatment. The bladder distension of the control group obtained a mean ± SD of 81.96 ± 9.4 and the treatment group 90.57 ± 10.78 with a p-value of 0.036, namely < 0.05, which means there is a difference in bladder distension in both the control and control groups. Treatment group.

Differences in the results of giving watermelon juice compared to mineral water on the enhancement of the urinary pelvis, ureters and bladder

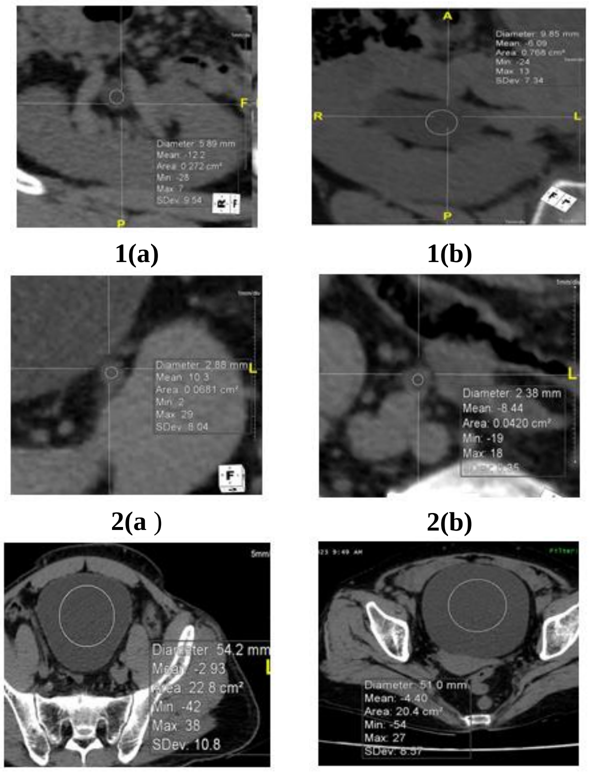


Figure 2. Visualization of Enhancement Control Group and Treatment Group 1(a) Control Renis Pelvis, 1(b) Treatment Renis Pelvis, 2(a) Control Ureter 2(b) Treatment Ureter and 3(a) Control Bladder 3(b) Bladder Treatment

Figure 2 shows the difference in image *enhancement* between the control and treatment groups in the pelvis of the control group -12.2HU and the treatment group -6.09HU. Ureteral *enhancement* in the control group was 10.3HU, and the treatment group was -8.44. Bladder *enhancement* in the control group -2.93HU and the treatment group -4.40HU.

The results of measurements of pelvic, ureter and bladder *enhancement in the control and treatment groups are shown in Table 4.*

Table 4. Enhancement *Measurement Results for Control Group and Treatment Group*

Object	No. Image	Water Group *Enhancement*	Watermelon Group *Enhancement*
Renis Pelvis	1	-12.1	-3.9
	2	-6.9	-1.6
	3	-12.1	-13.7
	4	-7.5	-9.6
	5	-8.8	-5.9
	6	2.4	4.0

Object	No. Image	Water Group *Enhancement*	Watermelon Group *Enhancement*
	7	9.8	17.0
	8	1.5	-6.4
Ureter	1	10.7	3.6
	2	25.5	7.1
	3	-3.9	-13.2
	4	-9.2	-13.4
	5	-10.6	23.9
	6	-2.1	-3.7
	7	27.9	-15.8
	8	-5.9	-8.6
Bladder	1	2.8	-6.1
	2	15.9	-3.3
	3	-7.6	-3.1
	4	-8.6	-9.3
	5	8.4	5.3
	6	-6.7	-3.8
	7	14.6	-2.7
	8	3.2	-4.5

From Table 4, it appears that the pelvic *enhancement* images of the treatment group in most images have higher *enhancement than the control group. Ureter enhancement* in the treatment group images in most images had lower *enhancement than the control group. The bladder image enhancement* of the treatment group in most images had lower *enhancement than that of the control group.*

a) *Enhancement* Difference Test for Control and Treatment Groups

enhancement normality test in this study used *Shapiro Wilk* because the sample size was < 50, and the results are shown in Table 5.

Table 5. Enhancement *Normality Test*

Enhancement	*p-value*	Information
Control	0.013	Not normally distributed
Treatment	0.017	Not normally distributed

**Shapiro-Wilk*

Table 5 shows that the control group's image *enhancement data* has a p-value of 0.013, namely <0.05, and the treatment group has *a p-value of* 0.017, namely <0.05, meaning the data is not normally distributed. Hence, the test that will be used is the *Man Whitney test*. The test results are shown in Table 6.

Table 6. Differences in Renis and Bladder *Pelvic Enhancement*
Urinary Control Group and Treatment Group

		Control *Mean* ± SD	Treatment *Mean* ± SD	*p-value*	Information
Enhancement	**Renis Pelvis**	-4.21±7.89	-2.51±9.47	0.599	There's no difference.
	Ureter	4.05±15.41	-2.51±13.49	0.294	There's no difference.
	Bladder	2.75±9.78	-3.44±4.14	0.345	There's no difference

**Mann Whitney*

Based on Table 6, information is obtained that *the enhancement* in the control group's tennis pelvis is *the mean* ± SD is -4.21 ± 7.89, and the treatment group is -2.51 ± 9.47 with a *p-value of* 0.599, namely > 0.05, which means there is no difference in pelvic *enhancement in both the control and treatment groups. The* ureteral *enhancement of the control group was obtained as a mean* ± SD of 4.05 ± 15.41 and the treatment group -2.51 ± 13.49 with *a p-value of* 0.294, namely > 0.05, which means there is no difference in ureteral *enhancement* in either the control group or the treatment group. *Enhancement* in the bladder of the control group, *the Mean was obtained* ± SD of 2.75 ± 9.78 and the treatment group -3.43 ± 4.13 with *a p-value of* 0.345, namely > 0.05 which means there is no difference bladder *enhancement in both the control and treatment groups.*

Differences in the image results of watermelon juice compared to mineral water on artefacts caused

Assessment of image artefacts for the control and treatment groups used a questionnaire filled out by five radiology specialists. After the respondents fill in the questionnaire, the data is summarized and tabulated, then processed using statistical tests. The characteristics of the respondents are shown in Table 7.

Table 7. Respondent Characteristics

Respondent	Profession	Work experience
1	Radiology Specialist Doctor	8
2	Radiology Specialist Doctor	6
3	Radiology Specialist Doctor	5
4	Radiology Specialist Doctor	6
5	Radiology Specialist Doctor	5

Based on table 7, it is shown that the five respondents involved in this research have work experience ranging from 5 to 8 years, which shows that the five respondents have good competence in their fields.

a. Agreement between respondents

Agreement between 5 respondents for assessing artefacts from images of the control and treatment groups was carried out using the Kappa test. The aim is to assess the similarity of perceptions between the five respondents and the results are shown in table 8.

Table 8. Kappa Test Results for Artifact Assessment in Control and Treatment Images

Respondent	Control	Treatment
R1*R2	0.543	0.610
R1*R3	0.778	0.644
R1*R4	0.568	0.396
R1*R5	0.568	0.396
R2*R3	0.778	0.273
R2*R4	0.568	0.385
R2*R5	0.568	0.385
R3*R4	0.579	0.407
R3*R5	0.579	0.407
R4*R5	0.579	0.448

Based on Table 8, the best agreement was found between Respondent 1 and Respondent 3 in assessing image artefacts in the control and treatment groups with values of 0.778 and 0.664, which means that the assessment between respondents had a strong agreement. Therefore, the respondents who will be selected are based on the best characteristics, namely respondent 1 with eight years of experience as a *clinical instructor (CI)*. Next, data processing was carried out based on data obtained from respondent 1. The results of the artefact assessment were then tested for data normality using the *Shapiro-Wilk test,* and the results are shown in table 9.

Table 9. Normality Test Results for Image Artifact Data for Control and Treatment Groups

	Group	*p-value*	Information
Artifact	Control	0.004	Not normally distributed
	Treatment	0.004	Not normally distributed

**Shapiro-Wilk*

Based on Table 9, it was found that all artefact data in the images of the control and treatment groups had a p-value <0.05, which indicated that the data was not normally distributed, so the next test was carried out using the *Mann-Whitney test*. The results were shown in table 10.

Table 10. Results of Different Image Artifact Tests for Control and Treatment Groups

Organ	*p-value*	Information
Upper Collecting System Artifact	1,000	There's no difference
Ureteral Artifacts	0.680	There's no difference
Bladder Artifacts	0.511	There's no difference

* *Mann Whitney*

Based on Table 10, it can be seen that the *p-value* of the Mann-Whitney test for each artefact criterion in the control group and treatment group has a p-value > 0.05; this shows that there is no difference in artefacts appearing in the images of the control group and the treatment group.

Analysis of Anatomical Information in Control and Treatment Groups

Assessment of anatomical image information for the control and treatment groups used a questionnaire completed by five radiology specialist doctors with 5 to 10 years of service.

b. Agreement between respondents

Agreement between 5 respondents to assess anatomical information from images of the control and treatment groups was carried out using the Kappa test. The aim is to assess the similarity of perceptions between the five respondents and the results are shown in table 11.

Table 11. Kappa Test Results for Assessment of Anatomical Information on Control and Treatment Images

Respondent	Control	Treatment
R1*R2	0.529	0.758
R1*R3	0.600	1,000
R1*R4	0.610	0.600
R1*R5	1,000	0.429
R2*R3	0.600	0.758
R2*R4	0.415	0.579
R2*R5	0.529	0.415
R3*R4	0.644	0.600
R3*R5	0.600	0.429
R4*R5	0.610	0.478

Based on Table 11, it was found that the best agreement was found in Respondent one and Respondent 3 in assessing image anatomical information in the control and treatment groups with values of 0.600 and 1.000, which means that the assessments between respondents had strong agreement. Therefore, the respondents who will be selected are based on the best characteristics, namely respondent 1 with eight years of experience as a *clinical instructor (CI)* and head of the Sidawangi Lung Hospital installation. Next, data processing was carried out based on data obtained from respondent 1.

The results of the image information assessment were then tested for data normality using the *Shapiro-Wilk test,* and the results are shown in Table 12.

Table 12. Normality Test Results for Anatomical Information Data Image of Control and Treatment Groups

	Group	*p-value*	Information
Anatomical Information	Control	0,000	Not normally distributed
	Treatment	0,000	Not normally distributed

*****Mann Whitney*

Based on Table 12, it was found that all anatomical information data in the images of the control and treatment groups had a p-value <0.05, which indicates that the data was not normally distributed, so the next test was carried out using the *Mann-Whitney test*. The results were shown in table 13.

Table 13. Test Results for Differences in Anatomical Information on Images of Control and Treatment Groups

	Group	N	Mean Rank	P value
	Control	8	40.50	
Anatomical information on the image	**Treatment**	8	40.50	1,000
	Total	16		

Based on Table 13, it can be seen that the *p-value of the Mann-Whitney* test for anatomical information in the control group and treatment group has a p-value of 1, namely > 0.05; this shows that there is no difference in anatomical information in the images of the control group and the treatment group.

Differences in image results of administration of watermelon juice and mineral water on distension of the urinary pelvis, ureters and bladder

This research was carried out by giving mineral water to the control group and 1 litre of pure watermelon juice to the treatment group each. Based on the results of the *Mann-Whitney* test, it was found that there was a difference in pelvic distension in both the control and treatment groups, there was no difference in ureteral distension in both the control and treatment groups, and there was a difference in bladder distension in both the control and treatment groups.

This is in line with researcher which used 40 mg *of furosemide,* where a significant increase in distension was obtained in the right and left renal pelvis (Faik et al., 2018) . Meanwhile, researcher used 20 mg *of furosemide,* which obtained good distension and opacification in *the upper collecting system* (Moazzen et al., 2021). Study researcher *who used 20 mgr of furosemide,* 3was able to increase distension of the renal collecting system (Sung et al., 2019) . Researchers study which used five mgr *of furosemide*, obtained a larger bladder volume with more appropriate attenuation (Ljungberg et al., 2021) . Meanwhile, in research which used brewed tea from 3 bags (5.55 gr with a *caffeine content* of 1.54 mgr), a significant difference was obtained in right pelvic distension, there was no difference in left pelvic distension, UPJ right and left UVJ (Yudha et al., 2020), .

The results of this study show that using watermelon juice can provide a better diuretic effect, with increased distention or dilatation of the pelvic pelvis and a higher bladder compared to water. This increase in distension is very important for assessing the location, number and location of stones and patient management in cases of urolithiasis, especially in planning appropriate surgical procedures. Increasing distension of the bladder is necessary to help detect stones and also help diagnose tumours and inflammation of the bladder wall.

In this study, ureteral distension was not different between the control and treatment groups. This is different from researcher which used 40 mg *of furosemide* where a significant increase in distension was obtained in the right ureter and left ureter (Faik et al., 2018) . According to the researchers, there was no difference in distension of the ureters due to the disproportionate *citrulline content* (0.716mg) in watermelon juice compared to the *furosemide content* in previous research (40, 20 and 5 mg *furosemide*) resulting in different effects on the diuretic (urine formation) produced. Besides that, the amount of urine produced by the kidneys is less so that less urine passes through the ureters, and the distension of the ureteral lumen is less than optimal. The ureters are two muscular tubes 25 to 30 cm long with narrow lumina, which drain urine from the kidneys to the bladder (Keith et al. F Dalley, 2016). Diuretics increase the amount of fluid in the collecting system and ureters, increasing distension.

The diuretic effect occurs through the competitive inhibition of adenosine receptors in the proximal tubule cells of the kidney and distal nephron to reduce sodium reabsorption. Diuretics also reduce the activity of Na/K-ATPase and Na/H exchangers and increase the activity of *Atrial Natriuretic Peptide* and *Nitric Oxide* in the kidneys. These changes will cause hyperemia in the glomerulus, stimulating increased peristalsis in the kidneys and ureters (Barghouthy et al., 2020). Increased urine volume in the urinary pelvis, ureters and bladder caused by increased urine production will result in distension of the renal pelvis, ureters and bladder.

Differences in the results of giving watermelon juice and mineral water on *enhancement* of the urinary pelvis, ureters and bladder

Enhancement in this study was used to assess *the CT number* of the pelvis, ureters and bladder. *CT number* calculation *software* is a standard facility available on *CT Scans* as a round marker known as ROI *(Region Of Interest)* (Hanusch et al., 2020). *The CT Number* value of a network is directly proportional to the density and attenuation coefficient (μ) of the network. This density difference will differentiate the body's structure and surrounding tissue.

The Whitney test obtained information that there was no difference in ureteral *enhancement in both the control group and the treatment group,* there was no difference in ureteral *enhancement* in both the control group and the treatment group, and there was no difference in bladder *enhancement in both the control and treatment groups.* Table 4.10 shows an insignificant decrease in *enhancement in the ureters and bladder in the treatment group.* This is following researcher which used brewing tea from 3 bags (5.55 gr with a *caffeine content* of 1.54 mgr), which resulted in an insignificant decrease *in enhancement in the bladder (before -3.39 HU* after -3.93HU) (Yudha et al., 2020),.

The results of researcher which used 40 mg *of furosemide* showed a significant reduction *in enhancement in the right* (Faik et al., 2018) . *They left renal pelvis, right and left ureter before* (15.67 HU, 10.75 HU, 13.82HU, 14 .61HU) and after the use of furosemide (-3.56HU, -5.03HU, 0.08HU, 0.76HU). Kumar's research (Kumar et al., 2010), which used 10 mg *of furosemide,* showed a significant reduction in bladder *enhancement (-0.1 HU given and 6.4 HU not given).*

The results of this study show that using watermelon juice does not increase image enhancement, and in fact, there is a decrease in the enhancement value. This phenomenon shows the diuretic effect of *citrulline* from watermelon juice, which causes an increase in the amount of urine produced so that organ hyperattenuation is reduced and decreases enhancement. This is following previous studies, which obtained a decreasing enhancement value. Obtaining negative *enhancement values* in the renal pelvis, ureters and bladder is influenced by the large amount of urine formed, thereby causing reduced organ hyperattenuation and reducing HU values (Giambelluca et al., 2017). Increased urine production results in decreased *enhancement*, this is because 96% of the water contained in urine has a HU value of 0.993861 gr/cm ^{3,} which is lower than the lumen of the urinary pelvis, ureters and bladder, which is 1.000000 gr/cm ^{3} in the form of muscle/ soft tissue.

The decreased enhancement value on non-contrast CT Urography examination shows that the greater the amount of water contained in the lumen of the urinary tract, the *darker the background area* compared to nearby organs, thus helping to confirm the diagnosis of stones in the urinary tract. Besides that, it helps improve visualization of the ureteral walls and detection of filling defects (Renard-Penna et al., 2020)

According to researchers, there was no difference *in enhancement* in this study due to the content of *citrulline* and Minerals (Potassium 92.76 mg/100g, Magnesium, Calcium, and Ferum) in watermelon do not have an *enhancing effect* on the image. Besides that, the diuretic effect of 0.716

mg of *citrulline* is not comparable to the *furosemide content* in previous studies (40, 20 and 5 mg), so it has a different effect on the diuretic (urine formation) produced (Sapara et al., 2022).

The difference in the image results of watermelon juice compared to mineral water on the artefacts produced

Artefacts are defined as anything that can result in errors in the measurement of transmission readings by the detector or inconsistencies between measurements and reconstruction (Pedersen et al., 2018). Artefacts can be caused by several reasons, namely inappropriate protocol selection, movement of patients, reconstruction process And equipment malfunction or damage. Specifically, an artefact is the difference between the CT number reconstructed in the image and the actual object's attenuation coefficient (energy weakening).

The respondents' assessment of the artefacts that appeared after the *Mann-Whitney test* showed no differences in the renal pelvis, ureters and bladder that appeared in the images of the control and treatment groups.

This is different from the results of researcher where the use of 20 mg *furosemide* in CT urography with contrast was able to reduce line artefacts in the renal parenchyma and was able to increase the detail of *the pelvicalyceal system* and *collecting system* without artefacts (Woźniak & Mitek-Palusińska, 2023).

Based on observations during the research, the images produced in the control and treatment groups showed no artefacts in the pelvis, ureters or bladder. According to researchers, *the Citrulline* content (716.57±24.80 µg/mL) in watermelon juice (Corleto et al., 2019) and other substances such as minerals (Potassium 92.76 mg/100g, Magnesium, Calcium, and Ferum) do not cause high differences *in enhancement. Hence, there are no artefacts in the resulting image.* Apart from that, during the scan, in both the control and treatment groups, the patients were very cooperative and could control the stimulation of urination so that there was no movement of the patient, which could cause artefacts.

Differences in Anatomical Information on Images of Control and Treatment Groups

Good image performance in CT urography, according to Nakamoto (2020), is that it can best depict the structure of the medulla and renal calyces as well as narrow ureteral segments, can depict renal calyces with the sharpest detail, shows the smoothest contour of the kidney and has less image noise. Low. There was maximum homogeneity of collecting system opacification and minimal intrarenal collecting system artefacts. Able to visualize the volume and distension of the kidney collecting system well to detect stones (Sung et al., 2019). The bladder volume is larger with good attenuation for detecting masses in its walls (Ljungberg et al., 2021).

Mann Whitney test for anatomical information in the control group and treatment group had a p-value > 0.05, which shows no difference in anatomical information in the images of the control group and the treatment group. Besides that, the mean rank value obtained in the control group and treatment group was 40.50, respectively; this shows that in subjective assessment, the results of the anatomical information on the images of the control group and the treatment group were the same; nothing was better.

According to the researchers, there was no difference in anatomical image information in this study due to the high water content in watermelon juice and the citrulline content of 0.716mg/L. This condition makes the resulting image no different compared to water. Without this difference, it is hoped that watermelon juice can be used as an alternative as a natural diuretic to replace water.

Based on the results of this presentation, it can be concluded that in this study, the results of subjective assessment of the anatomical information of non-contrast CT urography images produced using watermelon juice and mineral water were the same; neither showed a better result. The administration of watermelon juice as a natural diuretic in non-contrast CT urography examinations based on subjective assessment was not optimal, producing images with better performance in terms of anatomical information compared to water.

Studying the effectiveness and efficiency of using watermelon juice compared to water in this research, the effectiveness requires a longer process time for making watermelon juice (20 minutes) compared to just providing mineral water. However, based on observations during the research, the time needed to finish watermelon juice is relatively faster than water. Respondents felt more comfortable drinking watermelon juice with a better taste than water so they could finish it more quickly. In terms of efficiency, watermelon juice costs IDR 25,000 (twenty-five thousand rupiah), which is more expensive than water, IDR 8,000 (eight thousand rupiah). On the other hand, watermelon contains vitamins (A, B, C, and E) and minerals (Potassium 92.76 mg/100g, Magnesium, Calcium, and Ferum), which are beneficial for body health. Besides that, the sample selection in this study was very specific, with special criteria that did not affect physiology.

CONCLUSION

The conclusions of this study are: 1) There is no difference in the results of anatomical information on images between administering watermelon juice and mineral water as a natural diuretic in non-contrast CT urography examinations in producing good performance. 2) There is a significant difference in distension in the pelvis and bladder between watermelon juice and mineral water as a diuretic on non-contrast CT urography examination. in non-contrast, distension in the ureters shows no difference. 3) There is no difference in enhancement between watermelon juice and mineral water as a diuretic in non-contrast CT urography examinations of the renal pelvis, ureters and bladder. 4) There is no difference in artefacts between mineral water and watermelon juice as a diuretic on non-contrast CT urography examination.

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