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Application of ASIR and Windowing to Image Anatomical Information of CT Scan Stonography

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ABSTRACT

Background

One disadvantage CT Scan Stonography is generated imagery has a high noise level. Adaptive Statistical Iterative Reconstruction (ASIR) is the latest in image reconstruction method to minimize noise and improve anatomical information of CT Scan. CT Scan image display is also influenced by the setting Windowing.

Objective

Assessing optimization ASIR and Windowing on image of CT Scan Stonography to value optimal anatomical information of CT Scan Stonography.

Methods

The type of this study was quasi experimental with the post test only design. Samples of study about 10 samples in each treatment group implementation of the application ASIR with Windowing. Assessment anatomical information is conducted independenly by two radiologists, analyzed by using the Kruskal Wallis test and continuing with Mann Whitney test.

Results

There were difference between image anatomical information (p value < 0,001) after the application of ASIR and windowing.

Conclusion

The use combination of ASIR 40% with WW350 and WL64 is the most optimal for the image anatomical information on the image of CT Scan Stonography with mean rank 89,75.

Recommendation

Application of percentage ASIR 40% with WW350;WL64 at the image of CT Scan Stonography can be used to generate the most optimal image quality and anatomical information.

Keywords: ASIR, Image Anatomical Information, CT Scan Stonography

INTRODUCTION

Urolithiasis is a health problem that has a serious impact on almost all population in the world. Urolithiasis is a multifactorial disease caused by complex interactions between external factors and internal factors. External factors trigger the emergence of urolithiasis such as lifestyle, obesity, food habits and lack of fluids, while hormones, heredity and anatomical factors are the internal factors which trigger the emergence of urolithiasis (Yasui et al., 2016). Other factors that predispose to urolithiasis include diabetes, hypertension, hyperparathyroidism, metabolic syndrome, gout and chronic urinary tract infections (Cook, Lamb, Lettin, & Graham, 2016).

Common radiological examinations for the diagnosis of urolithiasis are Abdominal Plain Film and Intravenous Pyelography (IVP) photographs (Joffe, Servaes, Okon, & Horowitz, 2003). The weakness of these examinations is that the resulting radiograph is less informative because of many artifacts mostly caused by air and fecal material in the intestine, otherwise the IVP examination can not be performed in patients with high levels of creatine (≥ 2.0 mg / dl), and less informative in displaying non-calcified stone (luscent stone) (Bombiński et al., 2014).

Along with the development of Multislice Computed Tomography Scan (MSCT Scan), urolithiasis diagnosis can be done with Non Contrast Helical CT scanning (NCHCT) Urography or commonly called the Stonography CT Scan (Moussa & Mariapan, 2009). Stonography CT Scan has a sensitivity of 97.7%, specificity of 100% and False negative of 2% in diagnosing urolithiasis(Wang, Lin, Wei, & Chang, 2003)(Hartman, Kawashima, & LeRoy, 2006). Stonography CT Scan is able to produce good image resolution with fast examination time (Xiao-yun et al., 2012).

Another advantage of Stonography CT Scan is that examination is performed without the need for intravenous contrast media injection to the patient so as to prevent possible adverse effects of contrast media injections such as contrast media allergies or decreased renal function caused after contrast media injection (Wang et al., 2003). One disadvantage of CT Scan Stonography is that the resulting image has a high noise level (Guzinski, Waszczuk, & Marek, 2016).

One of the newest image reconstruction methods on MSCT Scan to minimize noise and improve image quality is by applying Adaptive Statistical Iterative Reconstruction or commonly referred to as ASIR (Vardhanabhuti, Loader, Mitchell, Riordan, & Roobottom, 2013)(Nagatani et al., 2015). The CT Scan image view is also affected by the Windowing setting. Windowing is one of the parameters that can significantly affect the quality of CT Scan image display (Sagara, Hara, Pavlicek, Silva, & Paden, 2010). Optimal image quality helps the accuracy in diagnosis, thus it can avoid errors in the diagnosis of patient illness (Bourne, 2010).

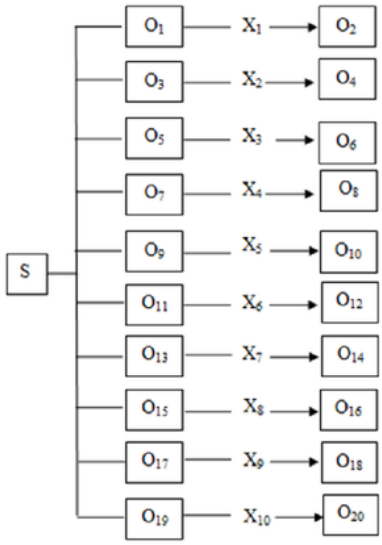
Previous study described that ASIR application was used in attempts to reduce noise and improve image quality on head CT scan examination primarily in organs in the posterior fossa region (Guzinski et al., 2016). Other study explained that the optimal ASIR value on examination of Heart angiography CT Scan was by using ASIR 60%.

In this study, the authors used ASIR (20%, 40%, 60%, 80% and 100%) combined with Windowing (WW400; WL40 and WW350; WL64) in Stonography CT Scan. Determination of ASIR of 20%, 40%, 60%, 80% and 100% was used because of these variations could made possible adjustment on CT Scan modalities used for the study (Leipsic et al., 2010). Windowing setting used WW400; WL40 and WW350; WL64 because previous study explained that windowing on Stonography CT Scan used WW350; WL64, whereas the Hospital used WW400; WL40 (Sagara et al., 2010).Based on these problems explained, the authors conducted the study on the use pf ASIR Application with Windowing on the image anatomical information of Stonography CT Scan Image.

METHODS

This study aims to determine the optimization of ASIR application and Windowing on the value of optimal image anatomical information of CT Scan Stonography. This study was conducted on the image reconstruction data of CT Scan Stonography by combining the use of ASIR application variation with Windowing variation.

The type of this study was quasi experimental with post test design. Selection of the study design aims to determine the changes after treatment (post test) in the treatment group. The subject of this study was Stonography CT Scan image. The study design is shown in the following figure:



This study used purposive sampling technique which is a technique in determining the samples with certain considerations in accordance with the desired study objectives (Sugiyono, 2011). The samples in this study were 10 samples in each treatment group of the use of ASIR application with Windowing.

This study was conducted through the stages as follows

a. Initial phase of the study, conducted by searching and identifying images of Stonography CT Scan with the case of urolithiasis on MSCT Scan.
b. The patients' identity and data on the Stonography CT Scan image were removed by anonymization (hiding the samples' identity).
c. Image post processing by performing a combination of ASIR application with Windowing. ASIR variations used here were 20%, 40%, 60%, 80%, 100% and Windowing variations were (WW400; WL40 and WW350; WL64)
d. The resulting images were then subsequently printed on the film for an anatomical information assessment by 2 Radiology specialists. Assessment was done by filling out the questionnaire on the assessment form.
e. The criteria of radiology doctor's who gave image assessment were 2 people in good health and had more than 5 years experience in interpretation of CT Scan Urography (Genitourinary Imaging).

Data analysis was performed through the following stages

a. Kappa test to analyze the appropriateness of image anatomical information assessment conducted by an observer. The result obtained was greater than 75% (k> 0.75), then the kappa test was said to be perfect (Razali&Wah, 2011).
b. Bivariate analysis of anatomical information which was performed using Kruskal Wallis, followed by Mann Whitney.
c. Determination of the optimal value of the combination of ASIR with Windowing in producing Stonography CT Scan image quality by looking at the highest mean rank value on anatomical information.

RESULTS AND DISCUSSION

Results and discussion contain the study findings and the discussion in scientific manner. The scientific findings obtained from the results of study that has been conducted must be supported by sufficient data. The scientific findings referred to here are not the data of study results obtained.

In this study, the highest anatomical information was obtained from the application of 40% ASIR, because the image generated on the application of ASIR 40% has the most optimal image quality that is the spatial resolution of organs or clear boundaries between the organs is very clear, this is evidenced by the number of 3 on the questionnaire by observers with a clear scale. WW350 window setting, WL64 also play an important role in the assessment of anatomical information of CT Scan Stonography image, because the windowing arrangement is able to show firm boundary between objects in CT Scan Stonography image. According to observer (radiolog), comparison of CT Scan Stonography image between WW400 windowing, WL40 with WW350 windowing, WL64 is in WW350 window setting, WL64 is like using fat suppression when on MRI image. So the anatomical picture of the organs examined will be more clear with firm limits.

Difference in anatomical information after application of ASIR and Windowing on Stonography CT Scan after discrimination test with Kruskal Wallis obtained p value of <0.001 (<0.005) which meant that there was a significant difference on anatomical information after application of ASIR and Windowing.

Determination of the optimal value of the combination of ASIR with Windowing in producing Stonography CT Scan image quality was performed by looking at the highest mean rank value on anatomical information. Mean Rank on anatomical information is shown on Table 1.1.

Table 1.1 The values of ASIR with Windowing which was optimum on the quality of image and anatomical information on Stonography CT Scan image

Treatment Variables	*Mean Rank*
ASIR 40%;WW350,WL64	89,75
ASIR 20%;WW350,WL64	70,75
ASIR 40%;WW400,WL40	64,70
ASIR 60%;WW350,WL64	62,50
ASIR 20%;WW400,WL40	49,05
ASIR 80%;WW350,WL64	46,10
ASIR 60%;WW400,WL40	45,85
ASIR 100%;WW350,WL64	33,70
ASIR 80%;WW400,WL40	26,60
ASIR 100%;WW400,WL40	14,00

Based on the above table, the author obtained ASIR with Windowing which was optimal on the quality of image and anatomical information on Stonography CT Scan image on the application of combination of ASIR 40% and Windowing WW350; WL64 with mean rank of 89,75. Image of CT Scan Stonography after application of ASIR and windowing had the most optimal anatomical information as shown in figure 1.

Figure 1. Image of CT Scan Stonography combination of ASIR 40% with WW350, WL64 that produced the mostoptimal image anatomical quality

CONCLUSIONS AND RECOMMENDATIONS

Application of a combination of ASIR with Windowing on Stonography CT Scan image was able to improved the quality of image anatomical information (p value <0.001). Application of a combination of ASIR 40% with WW350, WL64 was the most optimal for image qualityand anatomicalinformation on image CT Scan Stonography with the highest mean rank of 89.75.

Applicationof a combination of ASIR 40% with WW350, WL64 could be use to produce the most optimal quality of image and anatomical information on image CT Scan Stonography. For further study needs to be conducted in more and varied cases.

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