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Effectiveness Of Using Slice Thickness Of 1 Mm And 5 Mm To See Resolution Contrast In The Quality Of Ct Scan Images In Cases Of Hemorrhagic Stroke

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ABSTRACT

CT-Scan or computer tomography scans, are diagnostic aids that can be used to examine every organ in the body. A computer algorithm known as multiplanar reconstruction may produce axial, sagittal and coronal pictures from a stack of neighbouring transversal axial images. The operator modifies the slice thickness value based on clinical requirements. An incident that damages a portion of the brain is called a stroke. There are two types of stroke, ischemic stroke and haemorrhagic stroke. The purpose of this study is to determine which slice thickness in clinical haemorrhagic stroke can produce imaging data with good contrast resolution. The RSI Radiology Installation Siti Rahmah Padang served as the research site for this study. This kind of study is qualitative and descriptive. There were four respondents and one sample in this study, which included one patient, three radiographers, and a radiologist. In this investigation, we examined the variation in slice thickness, namely between 1mm and 5mm. since the study's findings indicate that using a 5mm slice thickness improves the quality of images when showing haemorrhagic–stroke images, a slice thickness of 5 mm produced an image that was ideal for diagnosis by physicians and had a good contrast resolution for printing. it can be said that using a 5mm slice thickness is the best way exhibit CT-Scan images.
Keywords: Cognitive System CT scan, Resolution of Contrast, Slice Thickness, Heart Attack,

BACKGROUND

Stroke is one of the leading causes of death and neurological impairment in Indonesia. Indonesia has had a 10.9% stroke prevalence during 2013, which is equivalent to 120 occurrences per 100,000 persons.(Riyadina *et al.*, 2020). Between the ages of 15 and 54, about 0.6–14.2% of these occurrences take place. Stroke also puts a financial strain on Indonesian households because it is expected to cost 10.7% of family income, which is more than other disorders. (Ministry of Health, 2013).

Hemorrhagic stroke occurs due to blood vessels leading to the brain experiencing leakage (bleeding) (Herpich and Rincon, 2020). The leakage is initiated by a sudden increase in pressure to the brain, causing the blocked blood vessels to no longer withstand the pressure, eventually bursting and causing bleeding. Bleeding generally occurs in the brain stem, the brain membranes (cortex), and the cerebellum. The leak causes blood not to reach its target, which is the brain cells that need a blood supply. If the blood supply is interrupted, it can be ensured that the supply of oxygen and nutrients needed by the brain will also be interrupted, and eventually, the brain cells will die.(Feske, 2021).

Computed Tomography (CT-Scan) is an imaging method that can be used to diagnose stroke (Dewilza and Yudha, 2023). Computed tomography (CT) scanning is an additional diagnostic tool that can be used to examine the entire body. Computerized tomography (CT) scan is a diagnostic imaging procedure that uses a combination of X-rays and computer technology to produce cross-sectional images (often referred to as slices) both horizontally and vertically of the human body (Ilma Fahira Basyir, Ninda Nurkhalifah, 2021). The latest generation of CT scans, MSCT 64 slice (Multi-Slice Computed Tomography Scanning 64 slice), can depict very detailed parts of the human body such as blood vessels, heart, brain, abdomen, large intestine, and head.(Russell *et al.*, 2020).

One of the objectives of the CT-Scan examination is to establish a diagnosis while considering image quality and patient safety through the optimization of the radiation dose used. In its development, CT-Scan has become an examination that provides accurate diagnostic information while considering radiation protection for patients and the significant costs involved during the examination (Dewilza *et al.*, 2023). In addition, the main source of radiation in medical imaging patients, the radiation dose to the patient's body during a CT scan is usually influenced by the use of milliamperes (mA) and kilovoltage (kV).(Irsal and Winarno, 2020)

In CT-Scan imaging, the influence of voltage on the CT-Scan image results can increase the X-ray tube voltage on the amount of radiation and photon energy. The tube voltage determines the distribution of the X-ray beam. The higher the X-ray tube voltage, the greater the dose received. Variations in X-ray tube voltage will cause changes in CT-Scan dose, noise, and contrast resolution. Variation in the thickness of the slices or sections of the examined

object. The thicker the slice, the more the image will tend to become an artifact, and if the slice thickness is thinner, the image will tend to become noise. CT-Scan examination of the head scan area is performed from the base of the skull to the vertex, using a slice thickness of 5 mm (Qiu *et al.*, 2020).

Image contrast resolution is the ability of an imaging system to distinguish two or more objects in an image that have very low density differences (low contrast resolution). The contrast resolution of an image is influenced by several input parameters, exposure factors, slice thickness, FOV, and filter selection (reconstruction algorithm), although there are some input parameters that do not affect the contrast of an image. This contrast resolution is also known as the sensitivity of the system, because it can detect density (difference in object density) ranging from less than 1% (0.25% - 0.5%) compared to conventional radiography, which only ranges around 10%. Contrast resolution is influenced by factors such as radiation dose and slice thickness. With the increase in radiation dose, it will also affect the increase in contrast. With the increasing thickness of the slice, the contrast will also improve (Vaclavik *et al.*, 2022)

Generally, a thicker size will produce an image with low detail, while a thinner size will produce an image with high detail. With a thicker slice thickness, contrast resolution will increase while spatial resolution and noise will decrease; conversely, with a thinner slice thickness, contrast resolution will decrease while spatial resolution and noise will increase (Zaky, Novita Andriani and Awal Bros Pekanbaru, 2020).

Head CT-Scan examination was performed using a slice thickness of 5 mm (Lin *et al.*, 2022). According to (Qiu *et al.*, 2020), it is explained that the CT-Scan Head examination is performed using a slice thickness of 5 mm (Qiu et al., 2020). Meanwhile, based on the conducted research, it is explained that the CT-Scan Head examination is also performed using a 1 range with a slice thickness of 5 mm (Saefudin *et al.*, 2015)

Based on the author's observation At RS Islam Siti Rahmah Padang, there are many patients with CT-Scan Brain for clinical Hemorrhagic Stroke, and RS Islam Siti Rahmah Padang has a different examination procedure using varying slice thickness. In the examination of the brain for clinical hemorrhagic stroke, the helical head technique is used, which employs a slice thickness of 1mm. The aims of this study to find out the difference in resolution contrast with the slice thickness settings used in CT-Scan Brain examinations with clinical haemorrhagic stroke and The use of which slice thickness produces good contrast resolution image quality in CT Scan Brain with a difference in slice thickness of 5mm and 1mm in clinical haemorrhagic stroke.

METHOD

The type of research conducted in this scientific paper is a descriptive study using a qualitative approach. The descriptive research method is a method used to analyze events that occur during the research period, conducted to obtain a picture of the current or ongoing situation. In this study, the descriptive method is used in the form of interviewing radiographers and radiologists to illustrate the differences in contrast resolution based on the slice thickness used. Contrast resolution is the ability to distinguish two or more objects that have a low density difference. Qualitative research is the collection of data in a natural setting with the aim of interpreting the phenomena that occur.(Sugiyono, 2019). This research was conducted at the Radiology Installation of RS Islam Siti Rahmah Padang in August 2024.

The data sources for this research come from primary and secondary data. Primary data is original data collected by the researcher themselves as a tool to answer the research problem formulation, whereas secondary data is data obtained or collected by the researcher from existing sources. This data is used to support primary information, where this data can be obtained from library materials, literature, previous research, books, and so on. Because the samples used in this study are patients who have undergone a CT Scan of the head for hemorrhagic stroke cases.

data needed to understand how The Contrast Resolution Imaging on Brain CT-Scan Examination with Clinical Haemorrhagic Stroke at the Radiology Installation of RS Islam Siti Rahmah Padang was collected using secondary data collection through interviews, observations, and documentation. Based on the type of data required, the participation of the researcher involves a group of people through in-depth interviews, observation, and documentation of respondents or key informants. This study has received approval from the hospital, radiologists, and radiographers who are the main sources of information in assessing the quality of CT scan images.

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RESULT AND DISCUSSION

Image 1 CT – Scan Slice Thickness 5mm slice 14

Image 2 CT – Scan Slice Thickness 1mm slice 14

During the in-depth interview, several questions were asked, leading to the following conclusions for each question:

Table 1 research result

Number	Question	Conclusion
1	How is the management of CT-Scan brain with clinical hemorrhagic stroke at Siti Rahmah Islamic Hospital Padang?	Management of CT Scan brain with clinical hemorrhagic stroke does not require special preparation, but we must ensure that there are no metal objects worn by the patient in the area to be scanned, such as necklaces and earrings. The protocol used is routine brain. The patient is in a supine position on the examination table, head first, with the CP 2 fingers on the vertex, and the parameters set to kV 130, mAs adjusted according to the range of the scanning area or the parameters adjusted according to the device settings, with an initial slice thickness of 5mm.
2	What is the effect of different slice thicknesses on resolution contrast?	The difference is because the initial slice thickness scanning results appeared shaky and seemed to move, so a reconstruction to 1mm was performed, which produced a better image but was still rough with less contrast. Therefore, the filming was done again with a reconstruction to 5mm to achieve a smoother, cleaner, and better image. Differences are also made to maintain the equipment so that the cube does not wear out and the equipment lasts longer and is more durable.
3	Is there a difference in contrast resolution when using slice thickness displayed in hemorrhagic stroke imaging?	The difference in slice thickness does not affect the contrast resolution for detecting bleeding on a CT scan of the brain. More influential on the appearance of non-hemorrhagic stroke.
4	Which description is good for filming and for the doctor to read?	Slicethickness 5mm is better at displaying bleeding images for filming.
5	What is the condition of a patient diagnosed with hemorrhagic stroke?	Hemorrhagic stroke can be seen from abnormalities in the blood vessels, which usually occur at a young age, through a CT Scan of the brain.
6	Why is a CT Scan of the Brain performed as the initial step to determine the diagnosis of hemorrhagic stroke?	CT Scan Brain examination is performed as an initial step because it is the easiest, fastest, clearest, or most sensitive to blood to determine the diagnosis of hemorrhagic or non-hemorrhagic stroke.
7	What is the difference between using slicethickness and contrast resolution?	Thin slicethickness will produce rough, blurry images with a lot of noise, resulting in lower resolution contrast and making the images appear darker. Thick slicethickness produces smooth and clear images, resulting in good resolution contrast.

After conducting research, the slice thickness settings used in the CT Scan Brain examination at RSI Siti Rahmah Padang showed differences during data acquisition and data reconstruction. After interviewing the radiographer, the author learned that the setting on the device with a slice thickness of 5mm during the initial scanning aims to make the CT Scan machine more durable. By choosing a thicker slice, the scanning duration is faster, so with a shorter time, the machine does not overheat quickly, which would otherwise cause wear and tear, leading to faster damage. Especially since the CT Scan machine is frequently used. In line with Qiu's research, 2020 explains that the thicker the slice, the more the image will tend to become artifact and if the thickness of the slice becomes thinner, the image will tend to becoming noise. CT-Scan head examination scan area is made starting from the base. cranium to the vertex, using a Slice Thickness of 5 mm and helping to extend the lifespan of the tool.(Qiu *et al.*, 2020)

Contrast resolution is influenced by factors such as radiation dose and slice thickness. With the increase in radiation dose, it will also affect the increase in contrast. With the increasing thickness of the slice, the contrast will also improve (Vaclavik *et al.*, 2022). In general, a thicker size will result in a less detailed image, and a thinner size will result in a more detailed image (Yudha *et al.*, 2023). On the one hand, a thicker slice thickness will result in higher contrast resolution and lower spatial resolution and noise; conversely, a thinner slice thickness will result in lower contrast resolution and higher spatial resolution and noise (Zaky, Novita Andriani and Awal Bros Pekanbaru, 2020)The initial scanning will produce images in the form of raw data (Dewilza *et al.*, 2023). This raw data presents images in an unclear form, such as movement during scanning, and appears blurry, resulting in poor image contrast with a lot of noise, and reduced spatial resolution. The image was reconstructed to a slice thickness of 1mm, resulting in better contrast resolution with less noise compared to before, and the spatial resolution also improved. Slice thickness of 1mm not only aims to improve image quality, but also the reconstruction results that will later be sent to the doctor's computer via PACS. Because the images produced using a slice thickness of 1mm have more slices obtained with smaller intervals between slices, the resulting images are more detailed, although the contrast resolution decreases with increased noise and spatial resolution. Thus, it can help doctors in making diagnoses or detecting small bleeding.

In addition to being reconstructed to 1mm, this CT Scan image was also reconstructed to a slice thickness of 5mm. the contrast resolution obtained in this image is better with slight noise, and the spatial resolution decreases due to the larger interval between slices, making the image appear smoother and cleaner. Whereas, based on the research conducted, it explains that the Head CT-Scan examination is also performed using 1 range with a slice thickness of 5 mm (Saefudin *et al.*, 2015). Additionally, images with a slice thickness of 5mm produce fewer slices due to the thicker slices and larger intervals between slices compared to the 1mm thickness. This aims to minimize the CT Scan film used, in addition, images with thicker slices, when printed, will produce a clean image to be given to the patient.

CT Scan examination with clinical hemorrhagic stroke at RSI Siti Rahmah Padang revealed that the author found differences in the slice thickness settings used during data acquisition and reconstruction. However, after interviewing the radiologist, the difference in slice thickness usage in clinical hemorrhagic stroke, as seen in one of the patients, does not indicate any difference in contrast resolution that can make it difficult for doctors to diagnose. After comparison, both images showed significant bleeding, with no differences and more hyperdense than other parts.

However, if we look at the image quality after conducting in-depth interviews with the radiographer staff, the author found that from the images presented during the interview, comparing the use of 2 (two) slice thicknesses, namely 1mm and 5mm, it can be seen that with the use of 1mm slice thickness, the contrast resolution image appears to decrease with increased noise, improved spatial resolution making the image look sharper, coarser, and the boundaries of the bleeding more clearly visible. When the slice thickness is more varied, the contrast resolution will decrease while the spatial resolution and noise will increase. Conversely, when the slice thickness is more varied, the contrast resolution will increase while the spatial resolution and noise will decrease (Zaky, Novita Andriani and Awal Bros Pekanbaru, 2020).

The use of a 5mm slice thickness shows an increase in contrast resolution with reduced noise, but spatial resolution decreases, resulting in a smoother and cleaner image. However, the boundaries of the bleeding are not well-defined, so the use of a 5mm slice thickness is more optimal for printed results that will later be handed over to the patient.

CONCLUSION AND SUGGESTION

The contrast resolution in the raw data from the image scan appears blurry, unclear, and seems to have movement. Reconstruction with a thin slice thickness results in low contrast resolution with a lot of noise, but good spatial resolution, aiming to assist doctors in making a diagnosis. Then, reconstructed using a thicker slice thickness, it resulted in increased contrast resolution, reduced noise, and the image appeared smoother, clearer, and suitable for printing. The use of a 5mm slice thickness is optimal.

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