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Relationship between Slice Thickness to Artery Coronary Diagnostic Information on the Reconstruction of Maximum Intensity Protection (MIP)

Authors
Siti Masrochah[1], Sri Mulyati[2], Benidekta Rosi Emaningtyas[3], Luthfi Rusyadi[4], Darmin[5], M. Irwan Katili[6], Rini Indrati[7]
[1,2,4,5,6,7]Politeknik Kesehatan, Kemenkes Semarang
Jl. Tirto Agung Pedalangan, Banyumanik, Semarang 50239, Indonesia
[3]Jogjakarta Panti Rapih Hospital

ABSTRACT

Introduction: *The selection of appropriate slice thickness on the processing of Maximum Intensity Projection (MIP) is crucial to obtain diagnostic information clearly on the coronary artery Cardiac Multi-Slice Computed Tomography (MSCT) examination in detecting abnormalities found in the coronary arteries.*

Objective: *As Maximum Intensity Projection (MIP) required a certain slice thickness to get the exact information to optimally diagnose coronary artery, this research aimed at determining an accurate slice thickness to obtain a clear picture of the coronary arteries required in image reconstruction.*

Methods: *This type of research is a quantitative experimental approach, using a sample of 10 patients that underwent MIP coronary artery reconstruction on the slice thickness variation of 5, 10, 15, 20 and 25 mm. The image of coronary arteries results is assessed subjectively by 3 radiologists to assess the diagnostic information by filling out the questionnaire. The data analysis was done by correlation test.*

Result: *Since the result of the p-value is 0.024 (p <0.05), it is concluded the existence of a significant relationship between the slice thickness with diagnostic information. Furthermore, the negative correlation coefficient of – (0.925),indicated that the relationship between slice thickness with diagnostic information is in opposite directions meaning the thinner the slice thickness the clearer the diagnostic information and the thicker the slice thickness, the blurred the diagnostic information.*

Conclusion: *From this study it can be concluded that there is a relationship between the slice thickness with diagnostic information on the treatment of coronary artery MIP with a negative correlation coefficient = -0.925 meaning the smaller the slice thickness, diagnostic information on the coronary arteries become apparent but the larger the slice thickness, the resulting diagnostic information is increasingly unclear. MIP reconstruction of the coronary arteries can produce clear diagnostic information to the slice thickness 5 and 10 mm.*

Keywords: *Maximum Intensity Projection (MIP), the coronary arteries, slice thickness, MSCT Cardiac.*

INTRODUCTION

Cardiac MSCT examination is performed to detect any abnormalities in the coronary arteries of the heart. This examination use the modalities a 64 slice Multi-Slice Computed Tomography (MSCT) that is able to provide information and analysis to the heart maximally so as to provide an assessment of morphology, anatomy and physiology of the heart, the details cardiac structures and variations, good image resolution

and capable of taking an image in a short time as the heart is constantly moving. According to Bongartz (2004), the reconstruction of images that can be performed in an MSCT Cardiac include Multi-Planar Reconstruction (MPR), Maximum Intensity Projection (MIP), Volume Rendering Technique (VRT), Curve Planar Reconstruction (CPR), Shaded Surface Display (SSD) and Fly Through.

The frequent MSCT Cardiac image reconstruction is Maximum Intensity Projection (MIP), which is the reconstruction process to find a picture of coronary artery in terms of Right Coronary Artery (RCA), Left Anterior Descending (LAD), Left Main Artery (LM), Left circumflex (Cx) by regulating the slice thickness. According to Pelberg Rober (2015), during the MIP processing, if the slice thickness used is too small then the detail produced will be less obvious, whereas if the slice thickness used is too big, small abnormalities are not visible that it is difficult to see the plaque in detail. Thus, the selection of appropriate slice thickness is very influential in providing diagnostic information required.

MIP reconstruction processing at Panti Rapih Hospital was often done using a variety of slice thickness. Since in the processing of the MIP reconstruction there have been no definitive guidelines for how the slice thickness is used to obtain an optimal picture of the coronary artery, it takes a longer time to carry out the reconstruction of the MIP. Besides the lack of proper slice thickness election can affect the resulting diagnostic information which can cause a Radiology Physician difficult in giving a diagnosis. Diagnostic information on the reconstruction MIP Cardiac MSCT examination is particularly necessary to specify the actions of cardiac catheterization so it is crucial to obtain optimal image processing in the coronary arteries. Consequently, a further assessment on the most accurate of the slice thickness is necessary to get an optimal coronary artery preview in MIP processing.

This research aims at determining the relationship between slice thickness at Intensity Projection Maximum Processing (MIP) of the coronary arteries to diagnostic information on Cardiac MSCT examination and to determine the appropriate slice thickness on the processing of Maximum Intensity Projection (MIP) Cardiac MSCT to produce the best diagnostic information.

METHOD

This type of research is quantitative research with an experimental approach. The population used is the Cardiac MSCT patients with a sample of 10 patients at the Cardiac MSCT MIP processing with slice thickness 5, 10, 15, 20 and 25 mm. The subjects of this study are the diagnostic information obtained from the processing of MIP with a slice thickness of 5,10, 15, 20, and 25 mm by 3 radiologist doctors acting respondents who have a service of 5 years and above and be competent to provide an assessment of Cardiac MSCT examination.

Information of anatomical image are MIP processing results in coronary artery include: Right Coronary Artery (RCA), Left Main (LM), Left Anterior Descending (LAD) and Left Circumflex (Lcx). Diagnostics information is done by assessing the clarity of image anatomy of the artery coronary by scoring 1-3 with categories *clear*, *quite obvious* and l*ess obvious*. Controlled variables in this study are a - 64 slice CT scan plane, exposition factors, FOV, window width, window level while independent variables are slice thickness of 5, 10, 15, 20, and 25 mm. The dependent variable is the diagnostic information of the coronary artery MIP processing consisting of RCA, LAD, LM and LCx.

The test results were then analyzed by using correlation analysis to find out the relationship between slice thickness at MIP processing of the coronary arteries with diagnostic information. The research decision is that Ho will be rejected if the p-value < 0.05 at the 95% confidence level meaning that the slice thickness is correlated to the processing of Maximum Intensity Projection

(MIP) of the coronary arteries to diagnostic information on Cardiac MSCT examination. Ho accepted if p-value > 0.05, which means that slice thickness has no relation to the processing Maximum Intensity Projection (MIP) of the coronary arteries to diagnostic information on Cardiac MSCT examination.

RESULTS

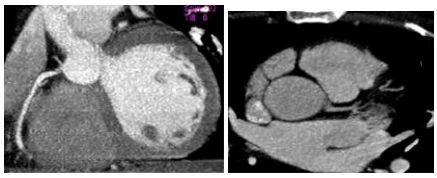
1. Characteristics of Sample

The sample in this study is ten (10) patients who request Cardiac MSCT examination. All samples in the category are adults aged 50-60 years with a diagnosis Medical Check Up, Coronary Artery Disease (CAD) and left chest pain.

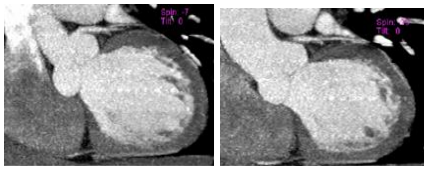
2. Description of Research Results

After examination of Cardiac MSCT in patients, the reconstruction MIP in the coronary arteries was performed. Later, it was shown the results of MIP processing radiographs with various slice thickness of 5, 10, 15, 20, and 25 mm.

a. MIP processing on each coronary artery with a slice thickness of 5 mm



a b



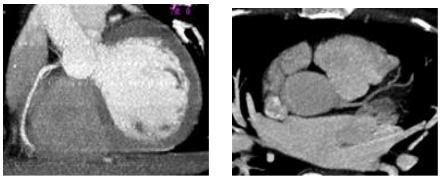
c d

Caption :

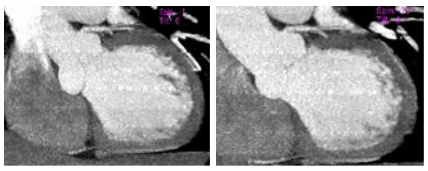
a. RCA c. LM

b. LAD d. Cx

b. MIP processing on each coronary artery with a slice thickness of 10 mm



a b



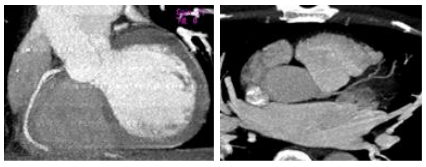
c d

Caption :

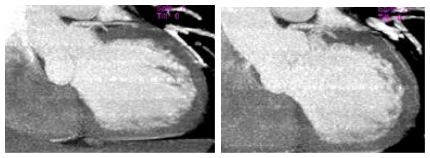
a. RCA c . LM

b. LAD d . Cx

c. MIP processing on each coronary artery with a slice thickness of 15 mm



a b



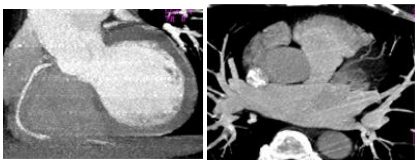
c d

Caption :

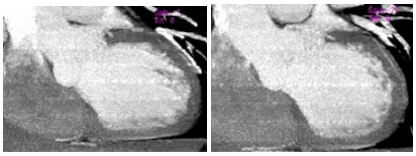
a. RCA c . LM

b. LAD d . Cx

d. MIP processing on each coronary artery with a slice thickness of 20 mm



a b



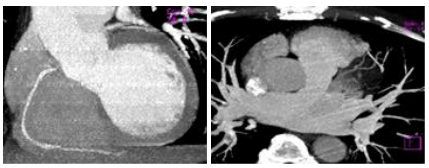
c d

Caption :

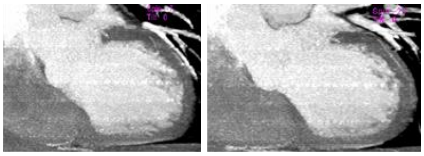
a. RCA c. LM

b. LAD d. Cx

e. MIP processing on each coronary artery with a slice thickness of 25 mm



a b



c d

Caption :

a. RCA c. LM

b. LAD d. Cx

MIP processing radiograph results are then passed to the radiologist to give an assessment on coronary artery clarity of diagnostic information by filling out a questionnaire provided.

From questionnaire, frequency of assessment are generated as follows:

Table 1. Frequency Recapitulation Assessment on MIP processing diagnostic information for each coronary artery

Slice thickness	Artery coronary	obvious	less obvious	not obvious
5 mm	RCA	97 %	3 %	0 %
	LAD	97 %	3 %	0 %
	LM	100 %	0 %	0 %
	LCx	100 %	0 %	0 %
10 mm	RCA	97 %	3 %	0 %
	LAD	97 %	3 %	0 %
	LM	97 %	3 %	0 %
	LCx	70 %	30 %	0 %
15 mm	RCA	83 %	17 %	0 %
	LAD	80 %	20 %	0 %
	LM	13 %	77 %	10 %
	LCx	7 %	77 %	16 %
20 mm	RCA	63 %	37 %	0 %
	LAD	57 %	43 %	0 %
	LM	0 %	53 %	47 %
	LCx	0 %	50 %	50 %
25 mm	RCA	50 %	37 %	13 %
	LAD	47 %	37 %	16 %
	LM	0 %	13 %	87 %
	LCx	0 %	7 %	93 %

After processing MIP coronary arteries on a slice thickness of 5 mm, 10 mm, 15 mm, 20 mm, and 25 mm and based on data obtained from the respondents, the diagnostic information of coronary artery looks obvious when processed with the slice thickness of 5 mm and 10 mm. Based on data from respondents, it is on the slice thickness of 5 mm and 10 mm coronary artery obtain the biggest percentage of diagnostic information as of 99.17 % and 90.8 %. This way, coronary arteries MIP processing will get clearly demarcated diagnostic information which is on the slice thickness of 5 mm and 10 mm.

After all, the data collected from the three respondents, are then analyzed with statistical tests to determine the relationship between the slice thickness on the processing Maximum Intensity Projection (MIP) of the coronary arteries to diagnostic information on Cardiac MSCT examination. The statistical analysis applies correlation test with the aid of SPSS software version 16 to determine the relationship of slice thickness with diagnostic information.

As the data were normally distributed, Pearson correlation test on each coronary artery was performed.

Based on the results of Pearson correlation test using SPSS the following results were obtained.

Table 2, Pearson Correlation Test Results in the coronary arteries

Slice thickness (mm)	Pearson Correlation	1	-.925*
	Sig. (2-tailed)		.024
	N	5	5
Informasi Diagnostic	Pearson Correlation	-.925*	1
	Sig. (2-tailed)	.024	
	N	5	5

*. Correlation is significant at the 0.05 level (2-tailed).

The table above shows the value of P-value generated is smaller than 0.024 $\alpha = 0{:}05$, so it can be interpreted that there is any significant or meaningful relationship between the slice thickness with diagnostic information. With the existence of a significant relationship, then Ho is rejected and Ha is accepted. Furthermore, from the statistical data, it is obtained the coefficient correlation of – (0.925) where the value is greater than 0.75, which means that the correlation between the slice thickness with diagnostic

information is strong. The correlation coefficient is negative which means that the relationship slice thickness with diagnostic information is in opposite directions indicating the thinner slice thickness the clearer the diagnostic information and the thicker the slice thickness, the unclear the diagnostic information.

DISCUSSION

1. *The relationship between the slice thickness on Maximum Intensity Processing Projection (MIP) of the coronary arteries to diagnostic information on Cardiac MSCT examination.*

Based on statistical test results, the p-value generated is 0.024. As the value is smaller than α = 0,05, it is concluded that there is a relationship between the slice thickness on the processing of Maximum Intensity Projection (MIP) of the coronary arteries to diagnostic information on Cardiac MSCT examination. This finding is consistent with the theory of Budoff et.al (2006) stating that Maximum Intensity Projection (MIP) is a three-dimensional reconstruction used to view the body tissue until the possible maximum intensity. MIP image presents a series of images that form the slab as a single image. A number of images included in the slab can be regulated and determined by the thickness of the slab.

Statistical tests show the correlation coefficient of - (0.925) which means that the slice thickness is strongly correlated to diagnostic information as the correlation coefficient is more than 0.75 and a negative value indicates the relationship between the slice thickness with diagnostic information in opposite directions. This means that the smaller the slice thickness the clearer the diagnostic information, otherwise the greater the slice thickness the more unclear the resulted from diagnostic information.

2. *Using the right slice thickness on the processing of Maximum Intensity Projection (MIP) to obtain diagnostic information*

Due to time constraints, this research uses a variation of 5 mm slice thickness, so that the author did not conduct research with a slice thickness below 5 mm.

Based on the results of the assessment from three respondents to clarify the information diagnostic coronary arteries with a slice thickness variations in processing MIP Cardiac MSCT examination, in a variation of 5 mm slice thickness, it is obtained a percentage of votes coronary artery diagnostic information which seemed obviously has the greatest percentage of 99.17%. Similarly, in a variation of 10 mm slice thickness, it is obtained a percentage of coronary artery diagnostic information which seemed obviously has the greatest percentage of 90.83%. In a variation 15 mm slice thickness, it is obtained a percentage of coronary artery diagnostic information that looks quite obviously has the greatest percentage of 55%. In a 20 mm variation slice thickness, it is obtained a percentage of coronary artery diagnostic information that seems clear enough to have a percentage of 50.83%. In a 25 mm variation slice thickness, it is obtained a percentage of coronary artery diagnostic information that looks clearly has a percentage of 61.7%.

Based on the assessment of coronary artery diagnostic information on the processing of diagnostic information, it is obtained MIP the clear MIP processing with a slice thickness of 5 mm and 10 mm i.e with a percentage of 99.17% and 90.83%. However, MIP processing on the slice thickness of 15 mm generates a percentage of 55% which falls under the category of clear enough diagnostic information.

This is in line with Pelberg (2015) stated that if during the processing of MIP, slice thickness used is too small then the detail produced is less obvious, whereas if the slice thickness used is too large, it can show stenosis but the small abnormalities are not visible, and it is difficult to see the plaque details.

According to the author this analysis in accordance with the theory that in order to get an overview of the diagnostic information of the coronary arteries and clearly demarcated on Cardiac MSCT examination, MIP processing with

appropriate slice thickness is required. This was evidenced in the results of the assessment percentage of respondents. In the MIP processing with a slice thickness of 5 mm and 10 mm, respondents stated that the diagnostic information of the coronary arteries was evident. Whereas the MIP processing with 25 mm slice thickness majority of respondents stated that the diagnostic information of the coronary artery seemed unclear. According to Bongartz (2004), the reconstruction of the MIP is used to see the picture of the coronary arteries by adjusting the thickness of the image of the picture. Based on the data obtained and supported with the theory, the obvious MIP processing is with a slice thickness of 5 mm and 10 mm in the area of RCA, LAD, LM, and LCx. In the MIP processing with a slice thickness of 15 mm RCA and LAD coronary artery are still clearly visible, while the LM coronary artery and Cx are seen quite clearly. In the MIP processing with a slice thickness of 20 mm, RCA and LAD coronary artery are still clearly visible and quite clearly, while the LM coronary artery and LCx seem enough clear and unclear. In the MIP processing with a slice thickness of 25 mm RCA and LAD coronary artery looks pretty clear, while the LM coronary artery and LCx are not clearly visible.

Based on this study and the data obtained, the authors conclude that the coronary artery MIP processing to obtain the right diagnostic information is by using a slice thickness of 5 mm and 10 mm as with these slice thickness, the diagnostic information of the coronary artery walls are visible and clearly demarcated. If the slice thickness used is too large then small abnormalities will not be visible. Thus, to get an optimal diagnostic information during the Cardiac MSCT examination in radiology services, it is advisable to use MIP processing of the coronary arteries with a slice thickness of 5 mm and 10 mm.

CONCLUSION

Based on the research that has been done that there was a significant association of coronary artery MIP processing using the slice thickness variations. The relationship between the slice thickness with the diagnostic information is very strong and in opposite direction that the thinner the slice thickness, the clearer the diagnostic information produced, while the thicker the slice thickness, then the unclearer the diagnostic information generated.

MIP processing of the coronary arteries on MSCT Cardiac examination with a slice thickness of 5, 10 and 15 mm generate quite clear and obvious diagnostic information while 20 and 25 mm MIP processing of the coronary arteries on MSCT Cardiac examination produce the unclear image. This way, it is concluded that the size of the slice thickness which can generate diagnostic information on coronary artery MIP processing to produce the demarcated coronary artery walls is the slice thickness of 5 mm to 10 mm.

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