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Analysis of the Effect of Age on the Absorption Dose of X-Ray Radiation in Thorax Examination

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ABSTRACT

This research aimed at finding out the effect of the patient's age on the absorbed dose obtained during the thorax examination. The observation data used is the exposure factor in the form of the tube voltage (kV), tube current (mA), irradiation time (s), and focus film distance (cm). The age range used is grouped based on the elderly age category established by the Ministry of Health of the Republic of Indonesia which ranges from 46 years until 85 years of age. From the data on the exposure factor and age of elderly patients, the oneway ANOVA statistical test was conducted. From the results of these statistical tests, the results obtained $F_{Calculate}$ value is 0,201 and sig 0,821 for Thorax AP examination and the results obtained $F_{Calculate}$ value is 0,790 and sig 0,476 for Thorax PA examination with the F_{Table} value is 3,81 and the sig is 0,05. Therefore, based on the testing criteria in statistics of the initial hypothesis (H_0) is accepted or it can be concluded that age does not affect the amount of X-ray radiation absorbed dose received by elderly patients in thorax examinations from the age range of 46 years until 85 years.

I. Introduction

In the health sector, the utilization of nuclear techniques includes radiotherapy and radiodiagnostic measures in the radiology department [1]. The radiology service unit is one of the medical support installations that uses ionizing radiation sources [2]. The ionizing radiation source must have a very large penetrating power so that it can penetrate the material it passes through, one example comes from an X-ray plane. With the use of X-rays, information about the human body is more easily known without having to perform surgical operations first [3].

Information about the human body can be known through images formed on the surface of the film formed due to differences in the intensity of X-rays hitting the surface of the film after some X-rays are absorbed by the human body [4]. The absorbed X-rays will affect the radiation dose received by the patient. Various examinations can be performed with X-rays, one example is a thoracic examination that can be performed for all age categories [5] including the elderly.

Previous research has been conducted by Widayati (2013) which aims to determine the absorbed dose received by pediatric patients and found that age does not affect the absorbed dose of X-ray radiation received by pediatric patients with an age range of 1 year to 15 years. Therefore, the purpose of this study is to determine the effect of age on radiation dose, especially the dose absorbed by the body of elderly patients who perform thoracic examinations. This is based on observations made in the field, where elderly patients perform more thoracic examinations.

II. Method

Data collection in the form of exposure factors in elderly patients with an age range of 46 years to 85 years for Thorax AP and Thorax PA examinations were carried out based on instructions from the radiographer. The patient is positioned according to the type of examination. For Thorax AP

examination, patients are invited to lie down on the examination table as shown in Fig.1 and for Thorax PA examination, patients are invited to stand in front of the examination equipment [6] as shown in Fig.2

Fig. 1. Patient Position for Thorax AP Examination

Fig. 2. Patient Position for Thorax AP Examination

The focal distance to the film in the Thorax AP examination is 100 cm and for the focal distance to the film or object in the Thorax PA examination is 150 cm [7]. The data that has been collected is then processed and analyzed based on the accepted dose of radiation exposure which can be mathematically calculated [8] as in the following (1) :

$$X = v^2.i.t \,/\, d^2 \quad (1)$$

X = Radiation Exposure Dose (R)

v = Tube Voltage (kV)

i = Tube Current (mA)

t = Irradiation Time (s)

d = Focus Film Distance (cm)

To determine the amount of exposure dose received by elderly patients. The exposure dose data is then converted into radiation absorption dose by multiplying the radiation exposure dose to the value of 0,877 Rad. Because 1 Roentgen is equal to 0,877 Rad dose in air, it is then converted to milliGray or mGy units [9].

Then, the data was grouped according to the age category of the elderly issued by the Indonesian Ministry of Health in 2009, as for the division is early elderly period is 46 – 55 Years, late elderly period is 56 – 65 Years, and elderly period is 65 Years and over [10].

The results of the dose acceptance were analyzed using the oneway method ANOVA (analysis of variance) method in the SPSS program. This method was used to determine the effect of the age of elderly patients on radiation absorption dose when undergoing thorax examination.

III. Results and Discussion

The results of the calculation of the absorbed dose received by elderly patients at the Thorax AP examination are then made in the form of a graph as shown in Fig 3.

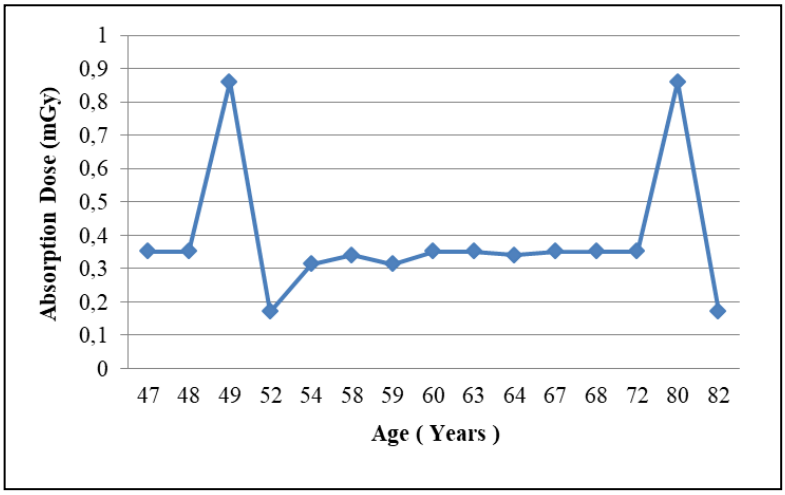

Fig. 3. Graph of absorbed dose received by elderly patients at Thorax AP Examination

From Fig. 3, it can be seen that the radiation absorbed dose received from the age of 47 years to 82 years is diverse or not the same. Furthermore, calculations were made to determine the average radiation absorbed dose received for each age category. The results of the calculation of the average absorbed dose are shown in Table 1.

Table 1. Average value of radiation absorbed dose obtained by elderly patients for Thorax AP Examination

Age Group	*Age (years)*	*Average X-ray Radiation Absorbed Dose*
Early Elderly	46 – 55	0,408
Late Elderly	56 – 65	0,338
Elderly	65 – 85	0,416

The data in Table 1 is then plotted graphically as shown in Fig. 4

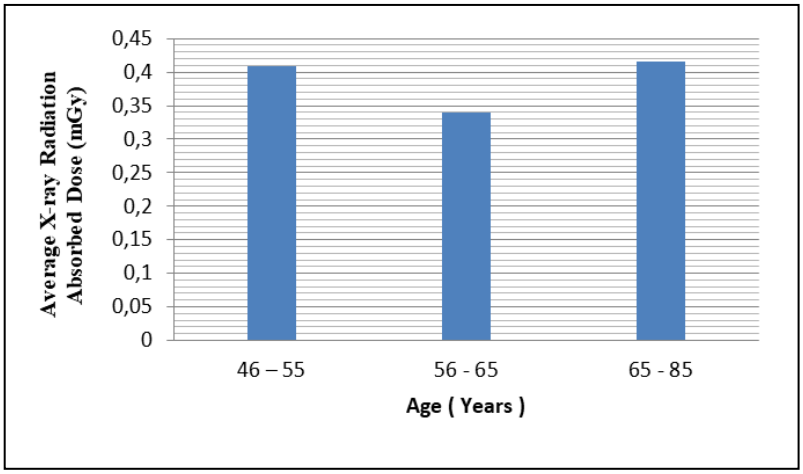

Fig. 4. Graph of the average absorbed dose received by elderly patients on Thorax AP Examination

From Figure 4 above, it can be seen that the average value of X-ray radiation absorbed dose in Thorax AP examination is highest in the age group of elderly patients. Meanwhile, the lowest

average value of absorbed dose is in the age group of late elderly patients. For the age group of early elderly patients, the average value of absorbed dose is lower than the elderly group and higher than the late elderly group.

The results of the calculation of the absorbed dose received by elderly patients at the thorax PA examination are then made in the form of a graph as shown in Fig 5.

Fig. 5. Graph of absorbed dose received by elderly patients at Thorax PA Examination

From Fig. 5, it can be seen that the radiation absorbed dose received from 46 years to 83 years of age varies or is not the same. The results of the calculation of the average absorbed dose are shown in Table 2.

Table 2. Average value of radiation absorbed dose obtained by elderly patients for Thorax PA Examination

Age Group	*Age (years)*	*Average X-ray Radiation Absorbed Dose*
Early Elderly	46 – 55	0,191
Late Elderly	56 – 65	0,116
Elderly	65 – 85	0,165

Data in Table 2 is then plotted graphically as shown in Fig. 6

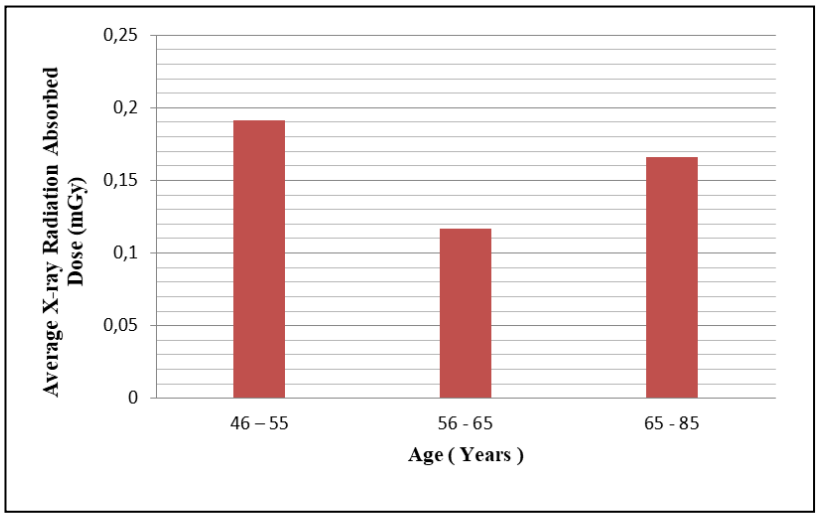

Fig. 6. Graph of the average absorbed dose received by elderly patients on Thorax AP Examination

From Fig. 6 above, it can be seen that the highest average value is in the age group of early elderly patients. Meanwhile, the lowest average value is in the age group of late elderly patients. For the elderly patient age group, the average value is lower than the early elderly group and higher than the late elderly group.

To determine the effect of age on the delivery of radiation absorption dose, Oneway ANOVA statistical test was conducted, with H_0 is that there is no effect of age on the delivery of radiation absorption dose in thoracic examination, H_1 is that there is an effect of age on the delivery of radiation absorption dose in thoracic examination, and the significance level α of 0,05. From the Oneway ANOVA statistical test, the results are as shown in Fig. 7.

ANOVA

X-ray Radiation Absorbed Dose For AP Thorax Examination

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	,068	2	,034	,805	,470
Within Groups	,504	12	,042		
Total	,572	14			

Fig. 7. Oneway ANOVA Statistical Test Results Elderly patients on Thorax AP examination

Based on the results of the oneway ANOVA statistical test in Fig. 7, it can be seen that the $F_{calculate}$ value (0,201) < F_{table} (3,81) or P (sig) (0,821) > 0,0500 which means that H_0 is accepted. This indicates that there is no effect of age on the administration of X-ray radiation absorption dose to elderly patients in Thorax AP examination.

ANOVA

X-ray Radiation Absorbed Dose For PA Thorax Examination

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	,014	2	,007	,790	,476
Within Groups	,108	12	,009		
Total	,122	14			

Fig. 8. Oneway ANOVA Statistical Test Results Elderly patients on Thorax PA examination

Based on the results of the oneway ANOVA statistical test in Fig. 8, it can be seen that the $F_{calculate}$ value (0,790) < F_{table} (3,81) or P (sig) (0,476) > 0,0500 which means that H_0 is accepted. This indicates that there is no effect of age on the delivery of X-ray radiation absorption dose to elderly patients in Thorax PA examination.

IV. Conclusion

Based on the research that has been done, it can be seen that the radiation absorption dose received by each age group is not the same and from the results of the One-way Anova statistical test it can be seen that there is no effect of elderly age on the provision of X-ray radiation absorption doses in patients with thoracic examinations.

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