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Analysis of Patient Radiation Dose and Quality of Radiograph for Adult Thorax Diagnosis Use High Kilo Volt Method

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ABSTRACT

Quality of radiographic images of thorax is influenced by radiation quality. Hence research is needed related to the effect of high kV method for adult thorax diagnosis. The effect of the radiation quality on the image can be known through the density of the film resulted from the stepping of the stepwedge object. The effect of high kV use on doses was done by analyzing incident air kerma on two radiography planes with Philips and Toshiba brands. From this study it was found that using of high kV method will caused image contrast to decrease when compared with standard kV method (generally used). But the image of the lung bronchus will be seen more than the use of standard kV method. In the use of high kV method can be done with a low burden tube (mAs), Thorax consists of lung organs and heart. It is moves or hard to resist so it is suitable for use because it takes a short time. The use of high kV method decreases the patient's acceptable dose by still producing an optimal diagnosis of adult radiographs.

Keywords : high kV, adult thorax, contrast, incident air kerma.

I. INTRODUCTION

To provide the right treatment is very necessary accurate diagnosis. So, to answer the problem is get the optimal quality image and very low dose received by the patient. Diagnosis of thorax images or better known as chest X-rays, is an diagnosis procedure using X-rays with the most done in radiology installations.

This is possible because thorax rays can be used to see the patient's general condition, chronic cough, diagnose lung disease or cancer metastases in other organs, preoperative requirements and medical check-up[1].Usually abnormal circumstances is beginning of the area of the lung is not normal[2].

High kilo volt is an diagnosis technique using variations of irradiation values in the form of a higher than standard voltage (kV) value with compensation decreasing current and time (mAs)[3]. In practice the use of high kV is more widely used for the diagnosis of the thorax and abdominal adults, meanwhile in pediatric patients it is rarely used. The use of high kV in patients has advantages, ie the dose received by the patient becomes smaller and the diagnosis time becomes shorter with optimum image results[4].

II. METHODOLOGY

Observations were made on two X-rays, the Philips X-40C and Toshiba DR-3724H at Columbia Asia Hospital Jl. Electricity No. 2A Medan and Bunda Thamrin Hospital Jl. Sei Batanghari No. 42 Medan. In

Philips and Toshiba x-ray, the dose is tested for accuracy related to dosimetry, tube voltage accuracy, irradiation time accuracy, linearity of radiation dose and reproducibility. After that, measurements on the pantom with the irradiation value obtained from field observations on the radiographer habits in providing the irradiation parameters, based on the estimated thickness of the adult thorax cavity. The analysis was conducted taking into account the doses including incident air kerma and the resulting image analysis.

III. RESULTS AND DISCUSSION

Test of Compatibility Using X-Tube Accuracy

The purpose of this measurement is to measure the accuracy of the voltage that the x-ray tube has. The data taken are the irradiation parameters with 10 kV voltage range from 50 kV - 140 kV, using the same mAs value of 20 mAs. From the data obtained there is a difference in tube voltage variation from 0.00% - 1.07% for Philips X-ray and 0.08% -160% for Toshiba X-ray, based on guidance taken from Nuclear Power Control Agency (BAPETEN) the value of each should not exceed 10%. Then the accuracy of the Philips x-ray voltage is still within tolerable limits.

In addition, the X-ray compatibility test also includes the accuracy of time with the irradiation parameters using a voltage of 70 kV with 200 mA, the radiation time range varies from 50 ms - 800 ms. The linearity campatibility test of radiation dose using 70 kV, with variation of 8 mAs and 16 mAs got the coefficient of radiation linearity generated 0.004 for Philips x-ray. As for the Toshiba x-ray radiation parameters conducted with a voltage of 70 kV, with variations of 20 and 40 mAs obtained the coefficient of radiation linearity generated 0.007.

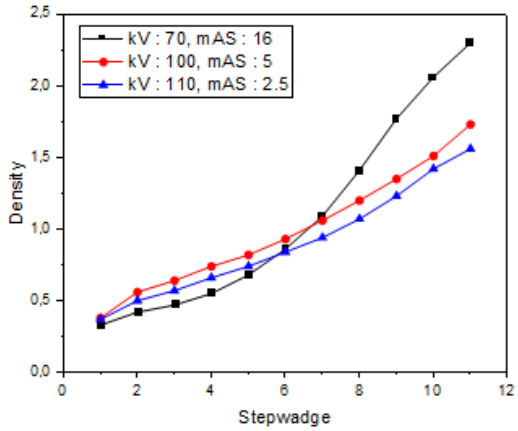

Figure 1. Graph films irradiated using Philips x-ray with eksposi factor thoracic irradiation in accordance with the examination Projection Antero Posterior (AP)

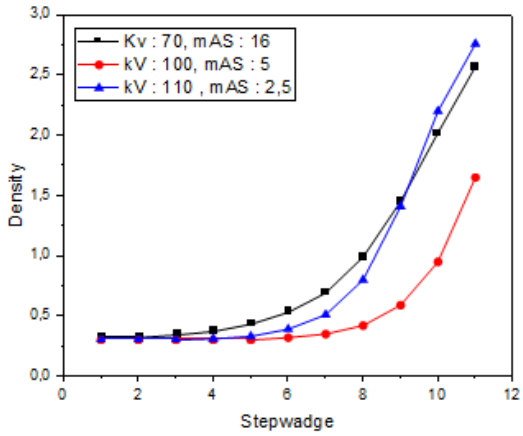

Figure 2. Graph the film is irradiated using Toshiba x-ray with eksposi factor thoracic irradiation in accordance with the examination Lateral Projection

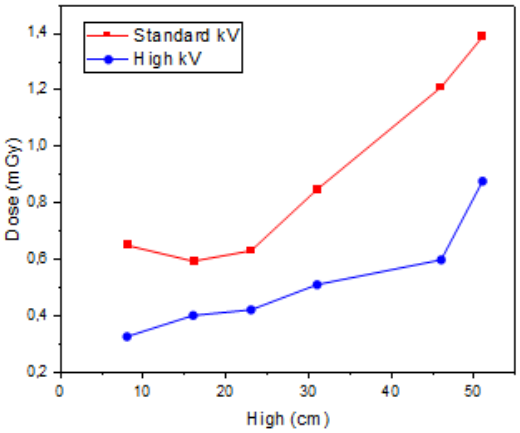

Figure 3. Graph of patient's thick comparison to incident air kerma (patient dose) on Philips x-ray

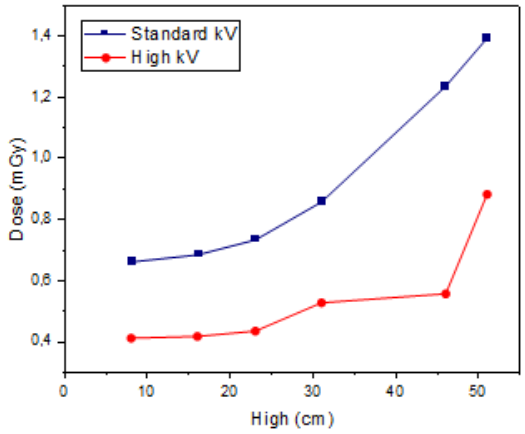

Figure 4. Graph of patient's thick comparison to incident air kerma (patient dose) on Toshiba x-ray.

The reproducibility test was performed with a voltage parameter of 70 kV, 20 mAs with a time of 100 ms, taken 5 repetitions with the same irradiation parameter. The reproducibility data of Philips X-ray shows the value of coefficient of variation resulting from the voltage of 0.00829%, the coefficient of variation from time of 1932% and the coefficient of variation of 0.722% radiation output. The reproducibility data of the Toshiba x-ray coefficient of variation resulting from the 0.004% voltage, the coefficient of variation from 0.003% and the coefficient of variation 0.011% radiation output. Based on the BAPETEN literature guidance each coefficient of variation should not exceed 0.005% then the reproducibility of the two planes is within tolerable limits.

Test of Contras Using Stepwedge

Test to obtain contrast ratio and density values in the film is performed by irradiation on films placed in cassettes with the appropriate irradiation parameters for adult thorax diagnosis, using kV standart method, and two types of high kV method. Data were calculated using a densitometer on an irradiated film using a Philips x-ray, with a radiation value of 60 kV and 12.5 mAs for standard kV, 100 kV and 5 mAs for high kV I, 110 kV and 2.5 mAs for high kV II can be seen in Figure 1.

From Figure 1 shows the highest density value in areas where there is no stepwedge (direct irradiated area) that is 2.75, while the lowest value in the non-irradiated area (the area covered by lead and is outside the collimation area) with a density value of 0.3, this area also becomes the fog base region of the film.

The same test was also showed on Toshiba X-ray with the results shown in Figure 2 below.

From the graph of film density illuminated by using Toshiba X-ray, it can be seen that the graph on the diagnosis using the standard has the steepest form, so that the resulting contrast becomes increased. For the high kVI and II, the resulting graph tends to slope, especially compared to films in standard kV irradiation method so that the density at each step is evenly distributed. This will cause the resulting contrast to be decreased.

The graph of high kV density range II is closer to the standard kV density range graph. Thus irradiation using high kV II is expected to produce more density or contrast which is almost equal to the density or contrast produced by irradiation by using standard kV.

Contrast Comparison of Adult Thorax Radiographs

Visual images of adult thorax radiographs with high kV decreased contrast than the contrast produced by standard kV. Adult radiographic images with high kV and standard kV can be seen in Figure 3.

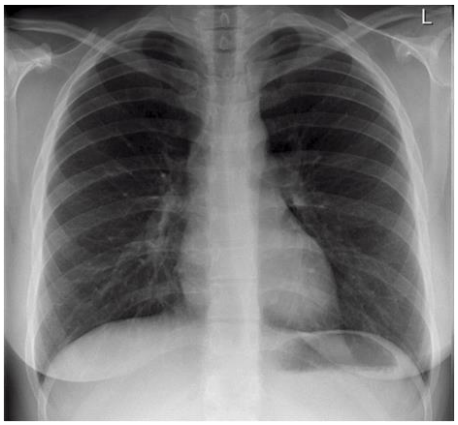

Figure 5. Radiographic images with standard kV

Figure 6. Radiographic images with high kV

On radiographic images of thorax with high kV, the bronchial image of the lung is increasingly visible. The decreasing factor of the overall image contrast and more visible bronchial shading on lung tissue is caused by the greater value of tube voltage used in high kV, thereby increasing the ability of the power to penetrate X-rays to the thorax organs it passes, either on lung tissue, tissue soft as well as bone tissue, so the resulting radiographic images will drop in contrast.

Analysis Incident Air Kerma

To obtain a comparison picture of the dose generated by Philips X-ray on a standard kV with high kV, a radiation condition commonly used for adult patient shooting, for stresses of 50 kV - 70 kV, 12 mAs. With *focus film distance* (FFD) 100 cm. Then we calculate using equation 1.

kVp1kVp25× mAs1 = mAs2 (1)

As the high kV I equation to obtain the new mAs value to be used, for kV with a range of 50 kV - 70 kV. As another comparison we can also use equation 2.

kVp1kVp24× mAs1 = mAs2 (2)

As a high kV II formula to obtain the new mAs values used, the voltages are used in the range of 50 kV - 70 kV. Thev alue incident air kerma on the Philips x-ray can be seen in Figures 5 and 6 for the value incident air kerma of the Toshiba x-ray. Fig. 5 and 6 show that high kV use on adult thorax diagnosis is able to decrease value of incident air kerma (dose of patient) received, as seen from high kV graphs resulting in lower dose ranges, when compared to standard kilo Volts resulting in the highest dose range .

IV. CONCLUSION

Visually, there is a difference in radiograph imaging from adult thorax using both radiation method, using high kV produces a picture of the lung bronchus seen more firmly and more than using standard kV, due to the wider radiographic contrast range. In Philips x-ray, the use of high kV decreases incident air kerma (IAK) with ranges from 32% to 50%, compared to using standard kV. While on Toshiba x-ray, the use of high kV decreases incident air kerma (IAK) with ranges from 36% to 52%, compared to when using standard kV.

Adult thorax diagnosis is recommended to use high kV, because of the lowervalue incident air kerma produced. Although the resulting thorax radiographic image decreases in contrast, it can provide an optimal diagnosis.

V. ACKNOWLEDGMENT

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