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Determination of Suitability Test on Digital Mammography Using Voltage Accuracy Parameter

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Abstrak

Determination of suitability test on digital mammography have been conducted from 20162018 at a hospital in Makassar City using voltage accuracy parameter. This measurement was used detector, and X-ray multimeter. Statistically, voltage accuracy parameter has correlation value, r = 0.866 (perfect correlation). While the p value obtained in voltage accuracy parameter is $p < 0.05$. There are significant differences in value from 2016-2018. The result of the suitability test for voltage accuracy parameter *is* still within the tolerance limit as recommended by the IAEA.

Keywords : *Voltage accuracy, digital, mammography, X-ray*

1. Introduction

Technological developments in the field of health, especially digital technology on mammography have been implemented since the 2000s. This development has a good impact on clinics and hospitals because it has replaced analog mammography units into digital mammography that has performance in accordance with screen film mammography with the advantage it display images that has high resolution [1]. Mammography is a radiographic technology used to examine and detect micro changes found in a woman's glandular tissue [2]. One of the benefits of mammography is being able to detect breast cancer early. Early detection can be done for the survival of breast cancer patients and it has been shown to reduce the mortality rate of breast cancer patients [3].

Measurements for detecting doses in breast gland tissue cannot be directly determined using X-ray mammography, but it can be determined based on certain standards according the breast characteristics and X-ray spectrum [4].

Small changes that occur in a mammography can produce a significant effect to radiation doses and image quality, so there are several factors that need to be considered including imaging techniques, patient position, equipment selection, and the establishment of an effective quality control program [5]. There are several studies about mammography including determining the mean glandular dose

(MGD) using ionizing radiation during mammography examination [6], measuring diagnostic accuracy and evaluating the MGD of digital mammography testing [5][7][8].

In addition, other studies are diagnostic of radiographic accuracy as a mammogram [9], calculating the average breast dose absorbed in mammography [10], and determining the patient's dose to determine the risk of ionizing radiation on a mammography [11]. Some of these studies are closely related to the suitability test of a mammography. Suitability test for mammography is very important to avoid errors in inspection that can make treatment more difficult and expensive [3].

Based on the recommendation of the International Commission on Radiological Protection (ICRP), the United States National Council for Radiation Protection and Measurement, the British Institute of Physics and Engineering in Medicine (IPEM), radiation dose measurements can be carried out using various approaches such as total energy transmitted to the breast, mid breast dose, incoming skin dose, air kerma, and MGD [4]. Another agency tasked with carrying out X-ray radiation protection is the International Atomic Energy Agency (IAEA). There are several tests highly recommended to determine the feasibility of mammography being able to operate safely for patients and non-patients. So that it is necessary to do measurement and suitability test on digital mammography by using voltage accuracy parameter. This measurement is expected to be able to produce a value passed the test on a digital mammography and meet the requirements as recommended by the IAEA.

2. Methodology

This study was conducted at a Radiology Installation of the leading hospital in Makassar. In this study used digital mammography GE brand, Senographe Crystal type in tube container and SHF-0510-M on generators/control panels with a maximum capacity of 35 kvp and 320 mAs. The tools and materials used in this measurement are ruler, X-ray multimeter, aluminum filter, PMMA (poly methyl methacrylate) phantom, and anode/filter is W/Rh.

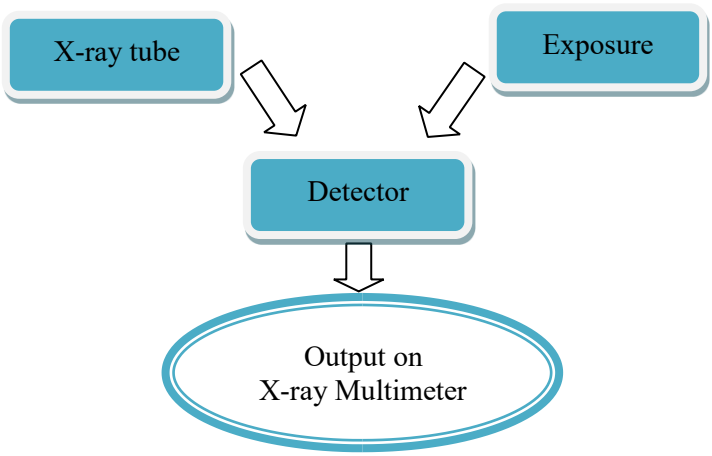

Figure 1. Schematic of suitability test on X-ray digital mammography

The exposure process is carried out under certain conditions of kVp and mAs after the detector is placed on the examination table on measuring the voltage accuracy parameter and it detect by X-ray multimeter. Determining of the suitability test of voltage accuracy parameter in digital mammography can be seen in the following equation:

$$Deviation = \frac{kVp_{set} - kVp_{measured}}{kVp_{set}} x100\% \quad (1)$$

Equation (1) is percentage deviation equation to determine accuracy of kVp. Where, $kVp_{measured}$ is the measured tube voltage and kVp_{set} is tube voltage setting. Voltage accuracy parameter of the calculation result is then analyzed using the SPSS application version 23.0 bit to determine pearson correlation and find out the data significance. Determination of data

significance was used the one sample T-test statistical test on the SPSS application.

3. Results and Discussion

Voltage accuracy test results on digital X-ray mammography with 50 mAs-set and 22 kVp, 27 kVp, 30 kVp from 2016-2018 are shown in Figure 2 below:

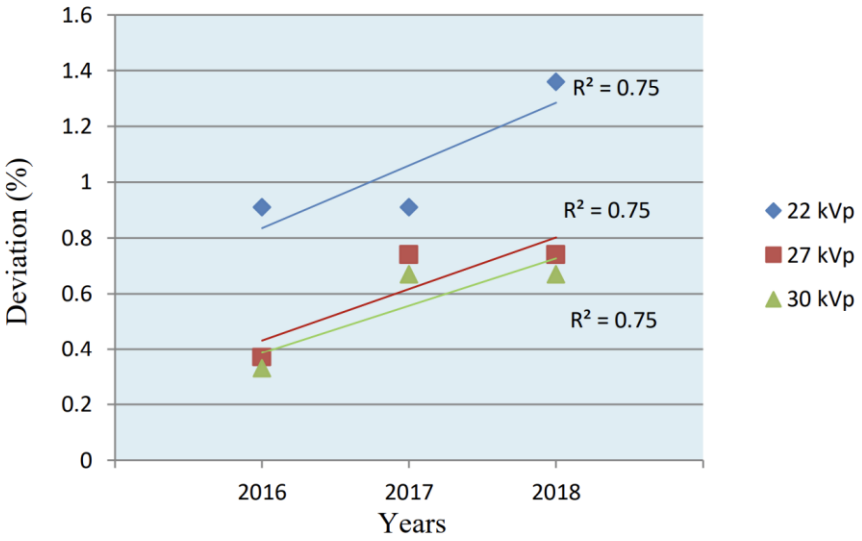

Figure 2. Graph of relationship percentage deviation from 2016-2018

The graph in Figure 2 displays the results of percentage deviation at 22 kVp, 27 kVp, and 30 kVp from 2016-2018. The graph has the same linearity level, $R^2 = 0.75$. Likewise with the level of correlation percentage deviation obtained from SPSS processing also has the same value, that is r = 0.866 (perfect correlation).

Data from the test results of digital Xray mammography using equations (1) as shown in Table 1 below:

Table 1. Suitability test results on digital mammography using voltage accuracy parameter.

Voltage	Accuracy	Parameter	Years			Ref. by Caroline, et al
			2016	2017	2018	
Percentage	22 kVp		0.91	0.91	1.36	
Deviation	27 kVp		0.37	0.74	0.74	0.3 [8]
(%)	30 kVp		0.33	0.67	0.67	

Voltage accuracy parameter in Table 1 is processed in the SPSS application to find out the significance of the test results using a one-sample test which is indicated by the p value produced. The value of p value percentage deviation at kVp 22, kVp 27, and kVp 30 are 0.006, 0.003 and 0.002 respectively. There are significant differences from 2016-2018 marked from $p < 0.05$. In Table 1, there is a reference by Caroline, et al that the values of voltage accuracy parameter has value approaching like reported them [8]. In addition, voltage accuracy parameter is the values of passed

test according to the tolerance limit recommended by the IAEA, where percentage deviation ≤ 5% [12]. The value in the table state that digital mammography can operate safely for patients and nonpatients.

4. Conclusion

The result of suitability test of voltage accuracy parameter has correlation value, r = 0.866 (perfect correlation). While the p value obtained in voltage accuracy parameter is $p < 0.05$. There are significant differences in voltage accuracy parameter of each value from 2016-2018. Measurement of voltage accuracy parameter on digital mammography that have been carried out is still in the standard tolerance limit recommended by the IAEA, that is the percentage deviation ≤ 5 %. This state that digital mammography feasibility to operate safely for patients and nonpatients.

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