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Verification of Dosage and Radiation Delivery Time Breast Cancer (*Mammae Ca*) with ISIS TPS: Sanglah Hospital Denpasar

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Isodoses Curve;

Abstract

Cancer was a disease caused of the abnormal growth of cells of body tissue turned to the cancer cells. For its development, these cancer cells can spread to other parts of the body, therefore, they can be the cause of the death. Cancer was a general term for all types of malignant tumors. It was one of the diseases required radiation therapy, namely breast cancer (*mamma ca*), wherein the breast cancer was the second type of cancer that causes of the death after cervical cancer for women. Radiotherapy was a cancer therapy used radiation sources at aiming to shrink and kill cancer cells as much as possible through the provision of the measured radiation doses on the tumor volume/target as well as to minimize the effects of the radiation on the healthy tissue around the tumor. The purpose of verification was to determine the suitability between the dose and time of irradiation of the radiation received by the patient with the radiation dose and irradiation time planned, thus, as not to experience a shortage or excess dosage and radiation irradiation time. The measurement of the dose and radiation irradiation time using constant *Source to Surface Distance (SSD)* techniques. The section handling the problem of the cancer therapy at Sanglah Hospital was in the Radiotherapy section of Radiology Installation. It was equipped with various medical support equipment, *i.e,* ISIS polling stations that conform to standard standards. The ideal dose criteria based on the *isodoses* curve was 95% minimal and 107% maximum about the target. The dose distribution was homogeneous. If the target dose has covered 100% then it can be stated that the plan was optimal. The verification of the dosage and time with ISIS TPS was in accordance with the Republic of Indonesia Minister of Health Regulation No. 363/Menkes/Per/IV/1998.

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Contents

1. Introduction

Cancer is a disease caused of the abnormal growth of cells of body tissue turned to the cancer cells. For its development, the cancer cells can spread to other parts of the body, therefore, they can be caused of the death. Cancer is often known as a tumor by the society, whereas not all tumors are cancer. The tumor is all lumps, not normal or abnormal. Tumors are divided into two groups, *i.e., benign tumors*, and *malignant tumors*. Cancer is a general term for all types of the malignant tumors and one of the diseases required radiation therapy, *i.e.,* breast cancer (*mamma ca*), wherein the breast cancer is the second type of cancer that causes of the death after cervical cancer for women [7]. The incidence of cancer is generally lower in developing countries compared to developed countries. Breast cancer is included malignant tumors in the breast tissue. This cancer can occur in conditions wherein the cell has lost control of its normal mechanism. WHO data (2013) explained that cancer patients increased from 12.7 to 14.1 million cases in 2014. Based on the Ministry of Health data (2014), the highest cancer in Indonesia for the women regardless of the age limit is breast cancer [3]. Handling radiotherapy is one way that doctors recommend. Due to it is able to handle breast cancer [8].

Cancer treatment methods with radiation can be either external radiation or teletherapy, internal radiation or brachytherapy, and radiopharmaceuticals. The method commonly used in radiotherapy is teletherapy. Teletherapy planes consist of Cs-137 therapy aircraft, *Linear Accelerator Aircraft (LINAC)* and Cobalt-60 (Co-60) therapy aircraft. Teletherapy Cobalt-60 is one the teletherapy airplanes located in Sanglah Hospital Center, Denpasar. The advantage of Cobalt-60 is emitted electromagnetic radiation. This radiation can cause as much damage as possible in cancerous tissue and as small as possible in the healthy tissue [6].

Kurniawan (2008) studied the radiation dose measurement. The study was discussed on radiotherapy patients with Cobalt-60 radiation sources using *Source to Surface Dose (SSD)* and *Source to Axis Distance (SAD)* techniques. The results obtained show that the radiation dose measured with SSD technique was still below the calculated dose, whereas with SAD technique only a few patients receive radiation doses exceed calculated. Suharsono (2012) researched verification of the radiation doses in phantoms was used the in-vivo method. Verification was conducted on a square field without blocks and on the field using blocks. The results obtained indicating verification on 60 square fields without blocks, diode dosimeters recorded differences in measured radiation doses towards randomized radiation doses in the range of ± 2.5%, while verification on the six fields using blocks was generated in the range of ± 3.5 %. The result is within the tolerable range that is allowed. The calculation of the unit monitor for each field is correct. Azizah (2016) verified the radiation dose of cancer using TLD-100 in the breast cancer patients in radiotherapy installation at RSUP Dr. M. Djamil Padang. The verification was conducted to determine the accuracy of the radiation doses for the breast cancer patients. Therefore, the radiation dose received by the patient was absolutely correct and does not exceed the tolerance limit of the allowable measuring instrument. The results showed that the deviation of the radiation dose accuracy ranged from -0.12 to 13.17%. Thus, the dose of radiation received of the five breast cancer patients was appropriate. Due to it is still in the range of uncertainty of measuring instruments.

2. Research Method

The implementation of the study began from the initial examination stage, simulation of patients with CT. Panning/CT Simulator to the planning stage of therapy using the ISIS Treatment Planning System. The measured includes the area of the breast cancer, the dose, and time of irradiation of the breast cancer radiation. Flowchart of ISIS TPS implementation for the breast cancer patients can be shown in Figure 1. [4].

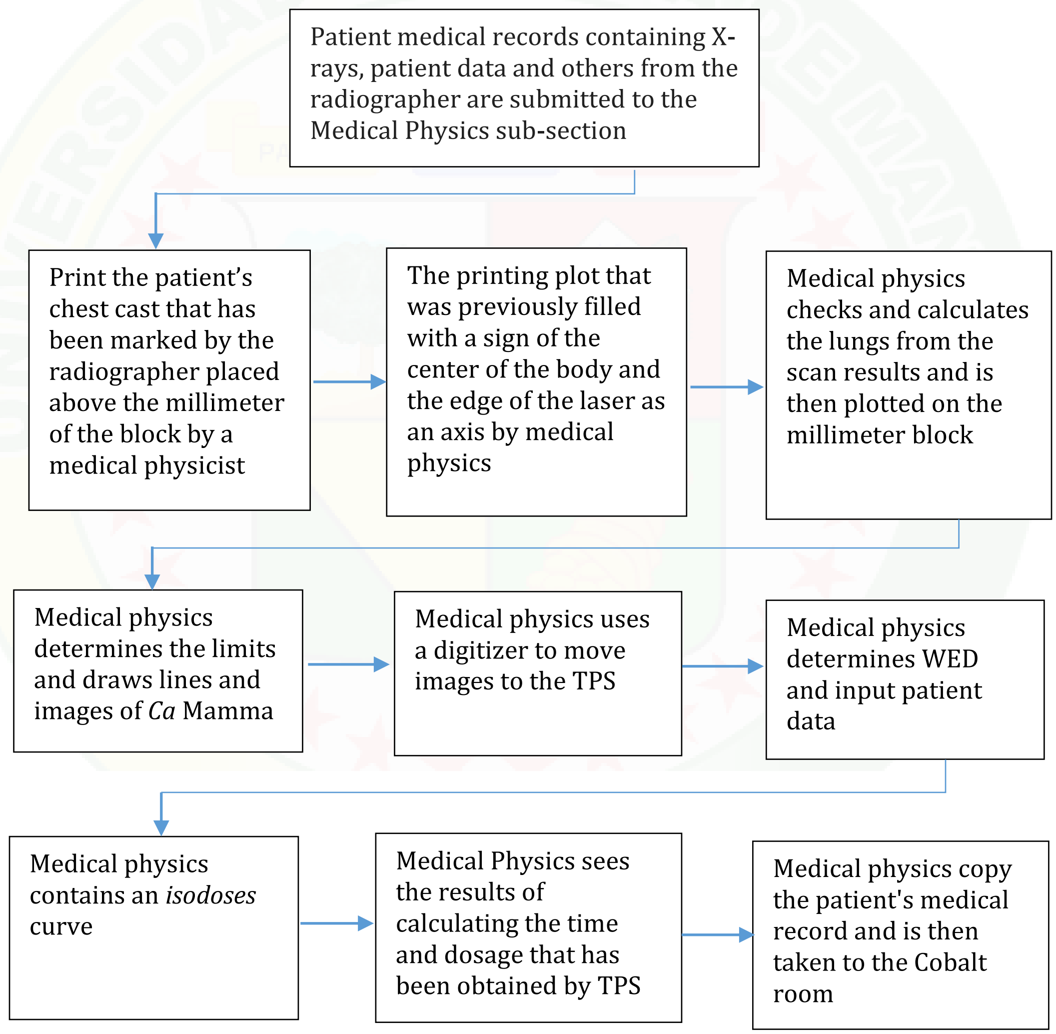

Figure 1. The flowchart implementation for determining the dose and irradiation time

3. Results and Analysis

Based on the data of breast cancer patients starting in 2016, 2017 and 2018 as many as 610 people as data in verifying dosage and irradiation time with ISIS polling stations as represented in Figures 2 and 3 as follows,

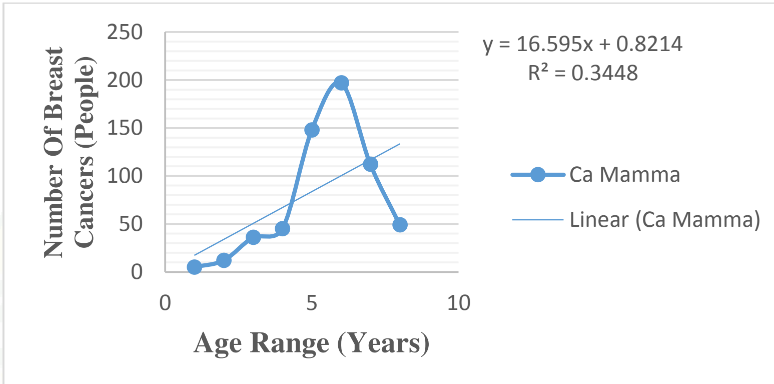

Figure 2. The number of breast cancer patients in Radiotherapy Agency, Sanglah Hospital Center.

Description: The age range 1 = <25, 2 = 25-29, 3 = 30-34, 4 = 35-39, 5 = 40-44, 6 = 45-49, 7 = 50-54, and 8 = ≥55 year.

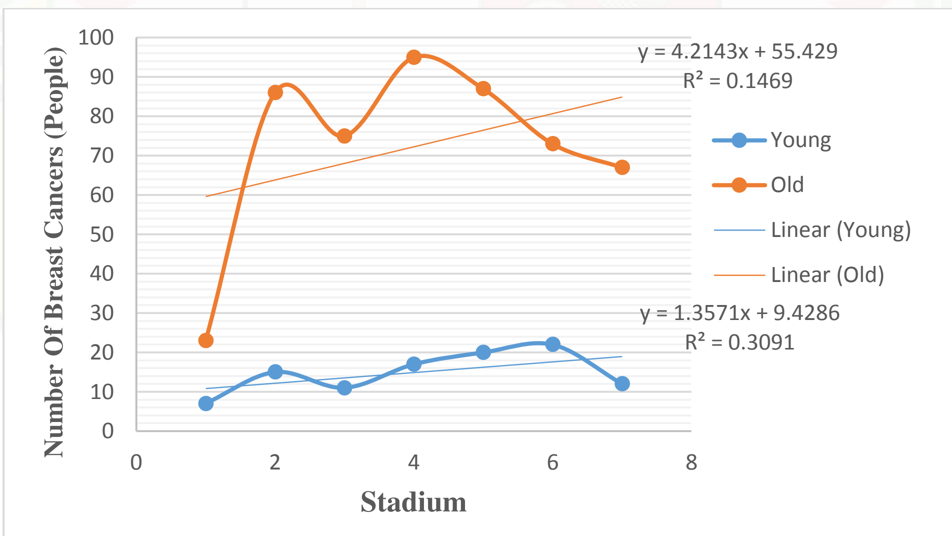

Figure 3. The number of patients with breast cancer the stage accordingly

Description: 1 = Stadium I, 2 = Stadium IIa, 3 = Stadium IIb, 4 = Stadium IIIa, 5 = Stadium IIIb, 6 = Stadium IIIc, 7 = Stadium IV

The expected data is in the form of the dose value and the right time for the treatment of the cancer patients in the Cobalt room by the radiographer.

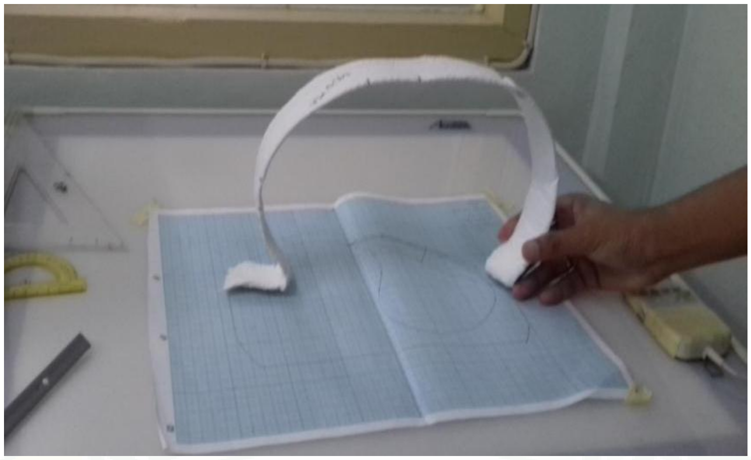

Figure 4. The casts of *mammae ca* patients who are ready to be forged into millimeter block paper

The initial step is taken by the patients with breast cancer after conducting an examination is to do a simulation in the simulator room. After simulating cancer in the simulator room and getting X-ray results from the form of cancer, the data is in the form of a patient's medical record, the patient's breast shape as shown in Figure 4 and the patient's photo sent to the Medical Physics room. The results and simulations of the breast cancer patients (*mammae ca*) are processed in the Medical Physics room by medical physicists using the necessary measuring equipment as shown in Figure 5 [1].

Figure 5. Digitizer and millimeter block paper for breast cancer patients

The first stage is performed by the medical physicists when getting patient data mammae ca is checking the cast that had previously been made by the radiographer in the simulator room, then the casting mold is forged on millimeter block paper. Therefore, the size of the patient's breast between the image and the original has the same size. Figure 6 shows a cast mold that matches the patient's body and then plots it into millimeter paper blocks according to the contour generated by the signal. The surface of the cast that was previously marked by the radiographer was forged on the millimeter of the block, then, the line was drawn in accordance with the restrictions on the cast. The line is in the form of a medial line, medical center, and gypsum boundary line. The medial and lateral lines are connected by drawing a line. To get a straight line out of the patient's body as in the figure can be determined by dividing the length of the medial and lateral lines that have been connected and drawn the line outward (to the surface of the skin)[5]. The next step is to draw the lungs with a benchmark from the patient's simulation photo. From the patient's simulation photo, we can measure the distance of the lungs with the *mamae*. The size obtained in the simulation photo is adjusted using a ruler to obtain the actual results. Regarding the measurement results obtained, the size was transferred to millimeter block paper for later depicting the shape of the lungs affected by the broad irradiation field. The thing that needs to be emphasized in this depiction is the inner line directly exposed to the irradiation field, while the lung image on the inside adjusts [10].

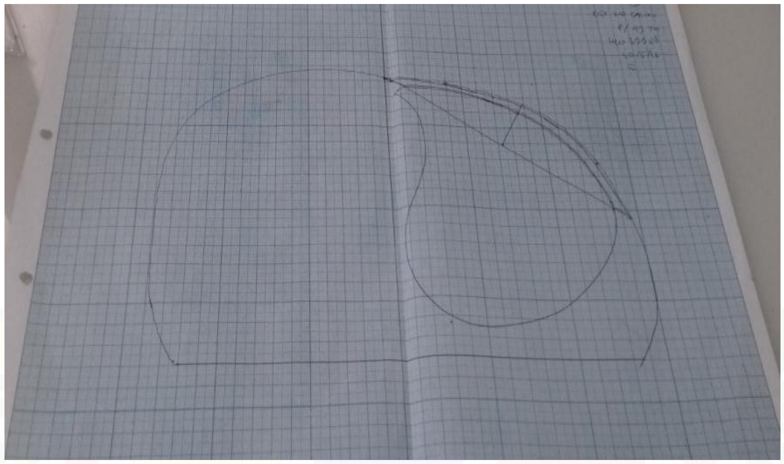

Figure 6. Drawings of casts on millimeter block paper in accordance with the roentgen results

The next step is the depiction of *CTV (Clinical Target Volume)*. The aim is to calculate the target to be irradiated, wherein the target must receive a dose of 100% and avoid protected healthy organs. The method for calculating CTV is intersecting the line following the lung contour and must have a distance of two millimeters from the lung.

After the CTV depiction, the next step is digitizing using a tool called a digitizer. It is shown in Figure 5. When starting to use the digitizer, means the use of TPS starts. In the TPS select the file, new menu, then create, and type the name of the patient. Then, to enter data from the digitizer select the slice, click the digitizer form until the field image appears on the TPS screen. The field image that appears is intended to create a field point (*orthogonal point*) from the image will be created. After the orthogonal line is formed, then the digitizer is conducted from the existing picture. Digitization can be started from an external contour, then point the digitizer by following the lines in the image. Thus, on the TPS screen dots appear that resemble the image in accordance with the original coordinates. Forging to insert images into TPS is also conducted for lung imaging and CTV. Therefore, a complete figure is the same as the figure have been made on millimeter block paper [2].

Figure 7. Digitizer Tools

The next step after the depiction complete is to determine the planning direction of radiation by determining WED as in Figure 8. It is *right*, so that, the ideal dose distribution curve is obtained. At the TPS the beam menu is found, select new, then select WED and enter the simulation image that has been finished. The CTV target is then shot in two directions, from tangential P and tangential P.A. The drawing angle is tilted the lungs are not much exposed to the radiation beam. Du to if the shot in a perpendicular direction the lungs will be exposed to the radiation beam as a whole.

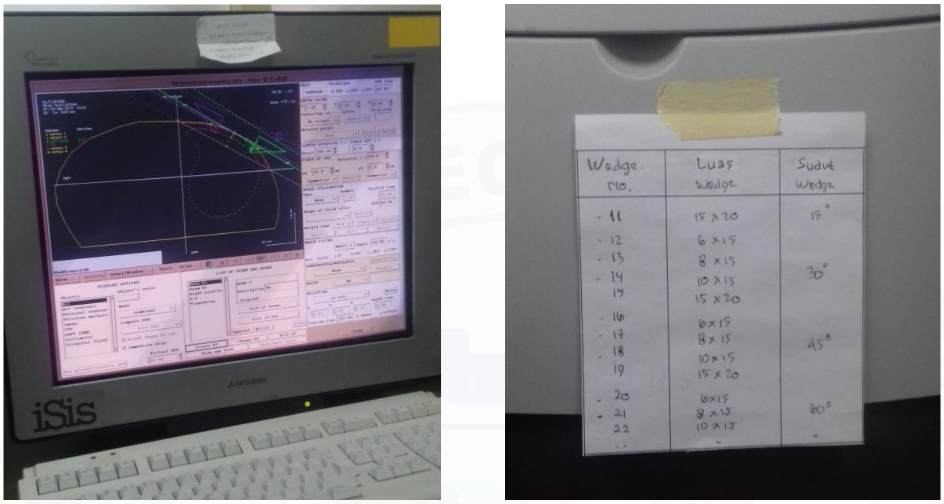

Figure 8. Planning direction and area of irradiation with ISIS 2D TPS

AP and PA tangential are distinguished by entering them in 2 different links so that the sloping lines are glued to the target, can be seen in Figure 8. (*left*).

The next step is to determine the irradiation technique that will be used, and the one chosen is the gamma beam. If the technical selection error occurs in this step, the result is a calculation error. The thing that needs to be ascertained is the suitability of the name of the equipment type to be used, in this case, is cobalt. Furthermore, the technique chosen is VCC. It is determining the distance from the radiation source to the skin surface. The intended distance is 80 cm from the source of radiation to the patient's skin. Then select gantry rotation to determine the direction of the beam. This can be seen from the medical record of the patient's simulation image. In the patient's medical record the magnitude of the angles which are medial-lateral and medial-lateral are stated. After entering the values of the angles, enter the field area entering the value of X (field width) and Y (length of the field).

Figure 9. Planning direction and the affected part of the beam

After determining the angular value, a line image will be formed on the TPS design of the breast cancer patients, the part irradiated is limited to an inverted triangle line image or called WED. The triangle image is placed upside down as shown in Figure 8. The aim is to make the part of the triangle that enters the organ as much as possible exposed to the radiation beam. It can be stated with a thick and thin section, wherein the thin part is wherein the beam of the light accumulates on the body, so that, a beam filter is needed. The use of a beam filter must be considered to be precise, the installation of a beam filter in the TPS and the radiation room must be the same, and thus, there will be no error. The end of the thick line is faced with a thin line while the thin end is treated with a thick line. It is conducted hope the dose distribution produced is homogeneous [5].

The calculation is conducted, the *isodoses* curve is obtained (the imaginary curve that connects any dose). All the points or areas in the image have their own dose, but to determine the right dose needs to be normalized looking at the doses at the meeting of the two lines that describe the direction of the shooting from the left and right sides. The meeting point of the two lines is used as a reference calculation of the normalization value. The right *isodoses* curve is obtained. The formed *isodoses* curve does not have to look good but still needs to be evaluated. The ideal dose criteria based on the *isodoses* curve are 95% minimal and 107% maximum about the target. The dose distribution is homogeneous. If the target dose has covered 100%. It can be stated that the plan is optimal. Figure 9 below shows one of the final results of determining the dose and irradiation time of the patient with mammary cancer who were taken randomly and the implementation of the TPS was in accordance with the procedure described previously.

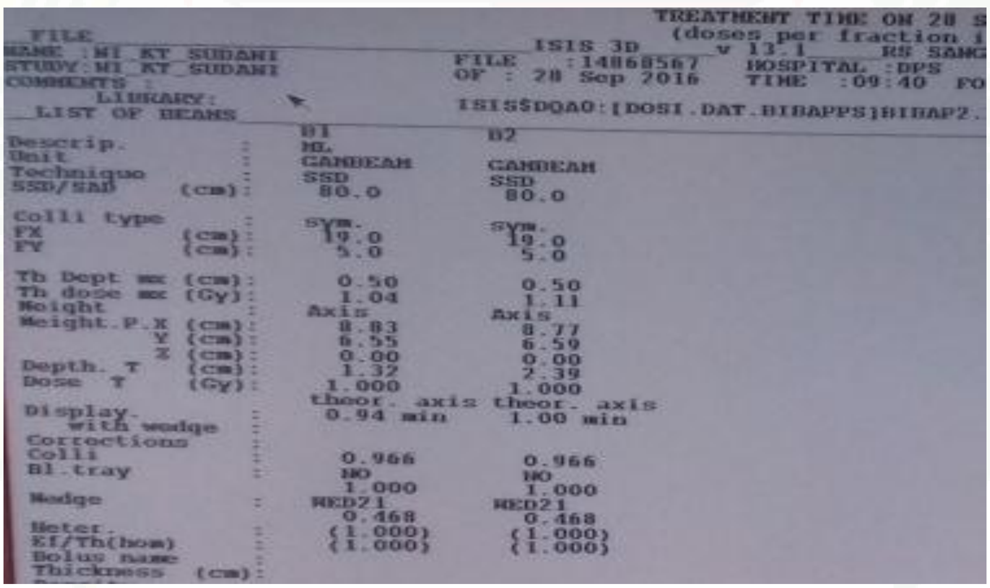

Figure 10. The dosage and irradiation time obtained using ISIS 2D TPS

4. Conclusion

The ideal dose criteria based on the *isodoses* curve are 95% minimal and 107% maximum about the target. The dose distribution is homogeneous. If the target dose has covered 100%, then, it can be stated that the plan is optimal. The verification of the dosage and time with ISIS TPS is in accordance with the Republic of Indonesia Minister of Health Regulation No. 363/Menkes/Per/IV/1998 concerning the test and calibration on health service facilities Article 2 section 1, stated that every medical device must be tested and or calibrated to ensure the correctness of the output value or performance and safety of use.

Suggestion

To guarantee the suitability of the medical devices, in addition to testing and/or calibration by BPFK or the competent body, it is necessary to periodically verify the Medical Physicists.

Conflict of interest statement and funding sources

The authors declared that they have no competing interest. The study was financed by Udayana University through DIPA BLU.

Statement of authorship

The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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