

COMPARISON OF CONSISTENCY VALUE OF ABSORBENT DOSE OF PLASTISIN AND SILICONE BOLUS USING ELECTRON WITH 6 MEV ENERGY AT SANGLAH RSUP DENPASAR

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Latar Belakang: Radioterapi merupakan suatu modalitas di bidang kedokteran yang berperan dalam pengobatan penyakit keganasan dengan memanfaatkan sinar pengion dengan memberikan dosis letal ke sel kanker dengan memberikan kerusakan yang seminimal mungkin pada sel normal.

Tujuan: dilakukan penelitian terkait adalah mengetahui perbandingan konsistensi dosis serap kedua bahan tersebut pada energi 6 MeV.

Metode: menggunakan penelitian dengan pengolahan data kuantitatif deskriptif untuk mengetahui perbandingan konsistensi nilai dosis serap bolus berbahan plastisin dan bolus berbahan silikon pada energi 6 MeV. Untuk mengetahui konsistensi nilai dosis serap bolus berbahan plastisin dan berbahan silikon dengan ketebalan masing masing 1 cm.

Hasil: didapatkan hasil nilai dosis serap yang nilainya bervariasi setiap harinya. Dimana untuk nilai dosis serap bolus berbahan plastisin rentang nilai dosis serapnya adalah 1,390 Gy sampai dengan 1,413 Gy, dengan persentase rata-rata deviasinya adalah 0,15%.

Kesimpulan: Nilai dosis serap yang diperoleh dengan menggunakan elektron energi 6 MeV selama 25 fraksi penyinaran didapatkan hasil nilai dosis serap yang nilainya sedikit bervariasi setiap harinya, Dimana untuk nilai dosis serap bolus berbahan plastisin rentang nilai dosis serapnya adalah 1,390 Gy sampai dengan 1,413 Gy, dengan persentase rata-rata

deviasinya adalah -0,38%, sedangkan untuk bolus berbahan Silikon rentang nilai dosis serapnya adalah 1,749 Gy sampai dengan 1,777 Gy, dengan persentase rata-rata deviasinya adalah 1,061. Rentang deviasi konsistensi dosis serap dari bolus berbahan plastisin adalah 0,002 dan rentang deviasi bolus berbahan silikon adalah 0,009.

Kata kunci: Absorben bolus; Radioterapi; dosis serap; konsistensi dosis serap

Abstract (English)

Background: Radiotherapy is a modality in the medical field that plays a role in the treatment of malignancy by utilizing ionizing rays by giving a lethal dose to cancer cells by causing minimal damage to normal cells.

Objective: related research is to know the comparison of the consistency of the absorbed dose of the two materials at an energy of 6 MeV.

Methods: used research with descriptive quantitative data processing to compare the consistency of the absorption dose values for boluses made from plasticine and boluses made from silicon at 6 MeV energy. To determine the consistency of the value of the absorption dose of boluses made of plasticine and silicone with a thickness of 1 cm each.

Results: The results obtained the value of the absorbed dose which the value varies every day. Where for the absorption dose of bolus made from plasticine, the absorption dose ranges from 1.390 Gy to 1.413 Gy, with the average deviation percentage being 0.15%.

Conclusion: The absorbed dose value obtained by using 6 MeV energy electrons for 25 irradiation fractions resulted in the absorption dose value which varies slightly every day, where for the absorption dose value of plasticine-based bolus the absorption dose value range is 1.390 Gy to 1.413 Gy, with an

average percentage The average deviation is -0.38%, while for boluses made from Silicon, the absorption dose ranges from 1.749 Gy to 1.777 Gy, with the average deviation percentage being 1.061. The deviation range of the consistency of the absorbed dose from the plasticine-based bolus was 0.002 and the deviation range of the silicone-based bolus was 0.009.

Keywords: Bolus absorbent; Radiotherapy; absorbed dose; absorption dose consistency

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BACKGROUND

Cancer is one of the leading causes of death and an important barrier to increasing life expectancy in every country in the world. According to estimates from the World Health Organization (WHO) in 2019, cancer is the first or second cause of death before the age of 70 in 112 of 183 countries and ranks third or fourth in 23 other countries (Beyzadeoglu, Ozyigit, & Ebruli, 2010). The increasing prominence of cancer as the leading cause of death in part reflects the sharp decline in mortality from stroke and coronary heart disease when compared with cancer in many countries. Of all types of cancer, breast cancer in women showed the highest percentage of new cases when compared to 36 other types of cancer, which was recorded in GLOBOCAN 2020 as many as 2,261,419 new cases (11.7%) (Huq, 2006).

Based on Basic Health Research (Riskesdas) data in 2018, the prevalence of tumors/cancer in Indonesia showed an increase from 1.4/1,000 population in 2013 to 1.79/1,000 population in 2018, where the highest incidence of cancer in women is cancer. breast, which is 42.1% / 100,000 population with an average mortality of 17% (Kemenkes RI, 2018). The reported province of Bali has a fairly high prevalence of cancer/tumor, namely 2.27% with 16,481 million cases (RISKESDAS, 2018). It is also supported by data taken at the Dharmais Cancer Hospital in 2018 showing that the highest cancer cases in Indonesia are breast cancer at 19.18%, followed by cervical cancer at 10.69%, and lung cancer at 9.89% (Kemenkes RI. , 2019). With a high prevalence, the role of curative modalities is in the spotlight to increase the life expectancy of these cancer

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patients. One of the modalities that has become the gold standard as a curative effort for cancer cases is radiotherapy.

Radiotherapy is a modality in the field of medicine that plays a role in the treatment of malignancy by utilizing ionizing rays by giving a lethal dose to cancer cells by causing minimal damage to normal cells. These ionizing rays can be electrons, X-rays, and gamma rays. In principle, the treatment method of radiotherapy with ionizing rays is to expose it to cancer tissue with external radiation (Beyzadeoglu et al., 2010).

Effective dosing is still a challenge in the application of radiotherapy in cancer patients. Giving a wide and excessive radiation field has the risk that too many healthy organs are involved in the radiation so that it will damage normal tissue, and cause tissue death, while a dose that is insufficient/inadequate to kill cancer cells will cause relapse/residence. It is endeavored that the radiation dose given to the tumor must be uniformly or homogeneously distributed in accordance with the International Commission on Radiation Units and Measurements (ICRU) guidelines, namely the maximum dose in the 95%-107% range. By planning therapy and giving the right dose of cancer will get the optimum dose and will determine the therapy. In its development, Linear Accelerator (LINAC) is present as an effective radiotherapy modality in carrying out more accurate radiation.

LINAC is a radiotherapy device that uses high-frequency electromagnetic waves by accelerating electron-charged particles so that they can irradiate tumor targets both superficially and at depth (Mirul, 1930). In irradiating breast cancer in mastectomy conditions or cancer cells located in the superficial area, electron beams from the LINAC and Bolus are usually used as tools (Wong et al., 2020). Bolus is a material whose attenuation coefficient and attenuation is equivalent to that of human body tissue which is placed directly on the body surface which serves to increase the dose on the skin surface, even out uneven body contours, and as compensation for the removed body tissue. The ideal bolus material is one that has the same attenuuity coefficient as human tissue, is able to stop light scattering and must be flexible and easy to shape according to the patient's various body surfaces, and most importantly not harmful to the patient's skin (Wong et al. , 2020).

The most frequently used bolus material today is a plasticine-based bolus. However, plasticine is very flexible and when pressed it cannot return to its original shape. This of course can reduce the optimization of the bolus in terms of the consistency of the absorbed dose from the beginning of the fraction to the end. Based on the coefficient and attenuation values equivalent to human body tissue, Silicone Rubber is an alternative to be used as a bolus material to replace plasticine. To ensure the consistency of the absorption dose values for boluses

made of plasticine and silicone, further research is needed that compares boluses made of plasticine with other materials, namely Silicon Rubber which is another material for making boluses. (Purba, 2018)("View of Study of the Use of Silicone Rubber Boluses on Surface Dosing in Electron Beam Radiotherapy," 2020) Based on this background the authors are interested in conducting research to test and compare the consistency of the absorbed dose values of the two materials and raise them to a in a study entitled "Comparison of Absorbed Dose Consistency of Bolus Made of Plasticine and Silicon on Electrons with 6 MeV Energy at Sanglah Hospital Denpasar".

METODE PENELITIAN

In this study, the authors used research with descriptive quantitative data processing to compare the consistency of the absorption dose values for boluses made from plasticine and boluses made from silicon at 6 MeV energy. Independent Variables; The independent variable is the variable that causes changes in the dependent variable. The independent variables in this study were boluses made of plasticine, boluses made of silicone. Dependent variable; The dependent variable (bound) is the variable that is affected. The dependent variable (bound) in this study was the reading of the absorbed dose of a bolus of 1 cm thickness at a depth of 2 cm (with phantom). Control Variables; The control variable (constant) is a variable that is controlled or fixed so that the relationship of the independent variable (free) to the dependent variable (constant) in this study, namely electrons with an energy of 6 MeV, 25 radiation fractions, slab phantom, ionization chamber, electrometer, temperature and humidity storage space.

Data analysis begins with obtaining the results obtained from the electrometer as many as 25 fractions. From the data and information obtained through recording the value of the absorbed dose reading on the electrometer, it will be analyzed further by calculating the deviation from the absorbed dose received per day. From the results of the data that has been processed, it will be obtained the consistency of the absorption dose of plasticine and silicon bolus doses with an energy of 6 MeV. The difference will be seen by using SPSS by applying the difference test of 2 variables. With the Independent T Test Difference Test if it is normally distributed or Mann-Whitney if the distribution of the data to be obtained is not normal with reference to the value of 0.05, so that conclusions can be drawn based on the hypothesis: The hypothesis is rejected (H_0) if the significance value of p value < 0.05 means that there is a significant difference between the consistency of the two boluses.

RESULTS AND DISCUSSION

The results of the measurement of the absorbed dose of the two bolus materials. The process of evaluating the consistency of the value of the absorbed bolus dose at the radiotherapy installation of the Sanglah Central General Hospital, measurements were made on the phantom without using a bolus once as a comparison for the value of the absorbed dose using a detector at a depth of 2 cm with a field area of 10 x 10 cm and SSD 100 cm. From this measurement, the absorbed dose from the phantom slab was 1.818 Gy. Subsequent measurements for 25 fractions with the same treatment were added using both bolus materials. The results obtained from measurements of room temperature and pressure and electrometer readings are the absorbed dose value in Gy units for 25 fractions (attachment 1) whose characteristics can be seen in Table 4.1 as follows.

On the first day, the result was 1,409 Gy for plasticine bolus and 1,749 Gy for Silicone bolus, these results were then used as a reference for calculating the consistency of the absorbed dose. To measure the average percentage deviation from the consistency of the absorbed dose, the following equation is used: Percentage Deviation = (absorbed dose value-consistency reference)/(consistency reference) x 100. Reference value: plasticine bolus 1.409 Gy Silicone Bolus 1.749 Gy

Statistical Test Results Absorb Dose Value Consistency

Based on the data obtained in the form of dose values and characteristics of dose deviations in both types of boluses, the researchers conducted statistical tests to be able to see the significance of differences in the distribution of absorbed dose values and their deviations. Before carrying out the different test, the researchers tested the normality of the data obtained with the following results: By using 6 MeV energy for 25 fractions of irradiation, it was obtained that the absorbed dose value varied slightly every day. 1.390 Gy to 1.413 Gy, with an average deviation percentage of -0.38%, while for boluses made from Silicon, the absorption dose ranges from 1.749 Gy to 1.777 Gy, with an average deviation percentage of 1.061%,

From the measurement results described in Tables 4.1 and 4.2, it can be seen that there is a difference in the value of the consistency of the two bolus materials where the average value of the absorbed dose of plasticine is 1.404 Gy and the average value of deviation of the absorbed dose is 0.002 Gy for 25 irradiation fractions. bolus made of silicon, the average value of the absorbed dose was 1.767 Gy and the deviation value was 0.09 Gy for 25 fractions. The results of the MannWhitney Statistical Test showed that there was no significant difference in the absorbed dose produced in the two types of boluses. This is due to several

factors, namely differences in temperature, air pressure, humidity, and the calibration factor of the electrometer. (IAEA, 2000) The two bolus materials have very good consistency values, there is no significant difference in consistency, it can also be considered from several factors, namely the absorption capacity of the silicone bolus is better than plasticine where the average absorption dose of the two bolus materials is closest to the measurement results. slab phantom without using a bolus material with an absorption dose of 1.818 Gy, where the average absorption dose of plasticine bolus is 1.404 Gy and a bolus made of silicon with an average absorption dose of 1.767 Gy not much different. It can also be seen in terms of efficiency and economy of the two bolus materials, where plasticine is easier to obtain, the manufacturing process is short, and the price of the material is cheap compared to silicone boluses.

CONCLUSION

Based on the description of the results and discussion in the research that has been carried out, the following conclusions are obtained; The absorbed dose value obtained by using 6 MeV energy electrons for 25 irradiation fractions resulted in the absorption dose value which varies slightly every day, where for the absorption dose value of bolus made of plasticine, the absorption dose value range is 1.390 Gy to 1.413 Gy, with an average percentage The average deviation is - 0.38%, while for boluses made from Silicon, the absorption dose ranges from 1.749 Gy to 1.777 Gy, with the average deviation percentage being 1.061. The deviation range of the consistency of the absorbed dose from the plasticine-based bolus was 0.002 and the deviation range of the silicone-based bolus was 0.009.

There was no significant difference in the deviation value of the absorbed dose in the plasticine and silicon bolus referring to the Mann-Whitney test results which showed a p-Value of 0.133 or > 0.05 , which means that there was no significant difference in the consistency of the absorbed dose shown by the two bolus materials. Based on the average value of the absorbed dose and the deviation range value of the absorbed dose of the two bolus materials in the statistical test using SPSS, the plasticine-based bolus showed a higher deviation value than the silicone-based bolus. Plasticine-based bolus showed better consistency in the application of 25 times fractionation.

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