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DETERMINATION OF PRESCRIPTION DOSE AROUND THE TARGET USING TPS 3D OCENTRA 4.5.3 ON Ca-THYROID

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Abstrak

Penentuan dosis terapi (Prescription Dose) di sekitar target menggunakan 3D TPS pada kasus Ca-Tiroid digunakan untuk melakukan contouring dalam bentuk 3D dari volume target Ca-Tiroid sehingga pada saat pengobatan dapat diperoleh dosis yang tepat untuk membunuh sasaran. tetapi juga meminimalkan efek yang diterima oleh OAR. Sehingga perlu diketahui tahapan dalam menentukan dosis terapi menggunakan TPS secara 3D dengan software yang digunakan adalah Oncentra. Penelitian ini dilakukan dengan menggunakan metode observasi dan metode wawancara dengan pembimbing lapangan. Dari penelitian ini didapatkan bahwa TPS 3D CRT merupakan teknik perencanaan CT sehingga dapat terbentuk kurva isodose sesuai dengan bentuk target volume. Penentuan dosis terapi (prescription dose) dapat dilakukan dalam empat tahap, yaitu tahap awal (pembukaan program), perencanaan awal (pembentukan kontur internal dan eksternal), perencanaan balok, dan perhitungan dosis. Sehingga dari keempat tahapan tersebut, dosis per fraksi OAR adalah mata kanan 2,01 Gy, mata kiri 0,73 Gy, lensa mata kanan 0,45 Gy, lensa mata kiri 0,19 Gy, dan sumsum tulang belakang 1,8 Gy. . Sedangkan dosis per fraksi untuk volume target adalah GTV 2.77 Gy, PTV 2.92 Gy, dan CTV 2.83 Gy.

Kata kunci: kontur, dosis, resep, terapi, TPS

Abstract

Determination of the therapeutic dose (Prescription Dose) around the target using 3D TPS in the case of Ca-Thyroid is used to perform contouring in 3D form of a Ca-Thyroid target volume so that at the time of treatment the right dose can be obtained to kill the target. but also minimize the effects received by OAR. So it is necessary to know the stages in determining the therapeutic dose using TPS in 3D with the software used is Oncentra. This research was conducted using the observation method and the interview method with the field supervisor. From this research, it was found that TPS 3D CRT is a technique of CT planning so that the isodose curve can be formed according to the shape of the target volume. Determination of the therapeutic dose (prescription dose) can be carried out in four stages, namely the initial stage (opening the program), initial planning (contouring internally and externally), planning beam, and dose calculation. So that from the four stages, the dose per fraction of OAR is 2.01 Gy right eye, left eye 0.73 Gy, right eye lens 0.45 Gy, left eye lens 0.19 Gy, and spinal cord 1.8 Gy. . While the dose per fraction for the target volume is GTV 2.77 Gy, PTV 2.92 Gy, and CTV 2.83 Gy.

Keywords: contour, dose, prescription, therapy, TPS

1. INTRODUCTION

Cancer is a disease that has the highest mortality rate every year (Fitriyah et al., 2020ab). Based on 2018 data from the International Agency for Research on Cancer, the World Health Organization

(WHO) estimates there are 18.1 million new cancer cases and 9.6 million deaths this year." (CNN Indonesia, 2018). With the increasing death rate from cancer health technology is required to create a renewal or improvement in cancer healing (Puspitasari et al., 2020). Various efforts or methods have been developed to reduce the death rate caused by cancer, several methods can be used, namely surgery, chemotherapy, immunotherapy, targeted therapy, hormone therapy or endocrine therapy, stem cell transplantation, and radiation therapy.

One of the cancers that are currently happening often of them is thyroid cancer. According to data from the registration of the Indonesian Association of Pathology Specialists, "Obtained thyroid cancer is ranked 9th out of the 10 most cancers in Indonesia." At Cipto Mangunkusumo National Central General Hospital (RSUPN), Jakarta, thyroid cancer ranks 5th after other types of cancer.

However, the high number of cancer patients is not in line with the methods used for cancer therapy in Indonesia. There are still many hospitals in small cities that are still not affordable for these cancer therapy methods. According to BAPETEN (2018) "There were only 37 hospitals recorded using radiotherapy modalities in Indonesia in 2018." One of them is Saiful Anwar Regional General Hospital, Malang. But at RsUD Saiful Anwar is also still limited modality owned, namely only teletherapy cobalt and brachytherapy.

Radiotherapy at this time is a much-needed therapy as therapy for cancer. The more and more developed facilities owned, it is expected to be able to reduce cancer prevalence in Indonesia. Radiotherapy aims to maximize the death of malignant cells and minimize the effects caused on healthy tissue around the target. So in radiotherapy, radiation must be at the right dose and the irradiation must be appropriate regarding the target, to reduce the effects caused and not hit healthy tissue. To minimize healthy tissue around the tumor exposed to radiation, irradiation techniques were developed from conventional 2D irradiation techniques to 3D conformal radiotherapy (3DCRT) irradiation techniques. With this technique, the radiation field is formed irregular according to the form of the tumor with the use of CT scans at the TPS (Treatment Planning System) so that the shape of the tumor can be determined in 3 dimensions (Astuti et al., 2018). At this time TPS became one of the most important components in cancer (radiation) therapy. TPS is used to adjust the dose at the target volume and reduce the dose for normal tissue or at-risk organs around it. There are various kinds of TPS, namely 2D, 3D CRT, IMRT, and IGRT. At RSUD Saiful Anwar used TPS 3D CRT in the depiction of the target dose. Therefore, to find out its use or application, the authors aim to determine the therapeutic dose in the organs around the target using TPS 3D CRT.

Based on the background description, this study aims to find out the use of 3D CRT TPS and its application and determination of therapeutic doses on organs around the target in thyroid cancer cases at Saiful Anwar Malang Hospital.

1.1 Radiotherapy

Radiotherapy is a method of treatment of malignant diseases (malignant) using ionizing rays, aiming to kill tumor or cancer cells as much as possible and maintain healthy tissue around the tumor or cancer so as not to suffer too much damage. The dose of radiation is determined by the size, area, type, and stage of the tumor or cancer along with its response to radiotherapy.

External Radiation

External Radiation or Teletherapy is external beam radiation therapy, the action used to deliver one or more X-rays or high-strength photon beams precisely to tumors from outside the body at a predetermined distance.

Internal Radiation

Internal Radiation or Brachytherapy is a method of radiation therapy by placing a radiation source near the target area.

1.2 Principles and Purpose of Radiotherapy

The principle of radiotherapy is to give a dose of radiation that kills the tumor to a predetermined area (target volume) while the surrounding normal tissue gets the minimum dose possible. This is strongly supported by technological advances in radiotherapy tools and advances from computers. Technological developments in the world of medicine cannot be denied to help people with diseases to recover from their illnesses and improve the quality of life of these sufferers (Stephens, O Frederick, 2009).

Radiation can be used for the following purposes:

a. Curative

The goal is to destroy all malignant cells, namely removing or eradicating tumors in local areas and regional lymph nodes.

b. Palliative

The goal is to eliminate or reduce symptoms so that it can improve the quality of life of patients. Given to cancer in an advanced stage, both locally and with metastasis for example in cases of malignancy complaints of pain due to bone metastasis with the threat of fractures and cases of bleeding due to malignancy (R. Susworo, 2007).

2. RESEARCH METHODS

The research was conducted at RSUD dr. Saiful Anwar Malang. The study was conducted by observation and interview methods in cases of Ca-Thyroid. Ca-Thyroid is a disease characterized by abnormal cell growth in the thyroid gland. The thyroid gland is an organ located in the front neck. Ca-Thyroid consists of 4 types, namely papillary carcinoma, follicular carcinoma, medullary carcinoma, and anaplastic carcinoma.

3. RESULTS AND DISCUSSION

3.1 TREATMENT PLANNING SYSTEM (TPS)

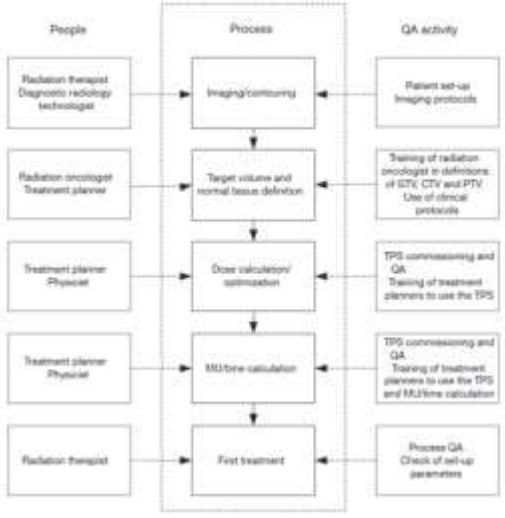
TPS is one of the important components in the radiotherapy process. TPS itself is a systematic process in making a radiation therapy strategy plan including the association of instructions from radiotherapy procedures containing physical descriptions, as well as dose distribution based on geometric or topographic information in imaging so that radiation therapy can be given appropriately TPS in producing images can be divided into two, namely 2D and 3D.

According to Prof. Dr. dr. Soehartati A. Gondhowiardjo, Sp.Rad (K), Onk Rad, as the Head of the Hospital Radiotherapy Department. Cipto Mangunkusumo (RSCM) "Radiotherapy used for the treatment of cancer patients there are several techniques, for example, Conformal Radiotherapy and Intensity Modulated Radiation Therapy (IMRT)/ Image Guided Radiation Therapy Radiotherapy. In the Radiotherapy Installation section at Saiful Anwar Malang Hospital using one of them is 3D CRT. 3D CRT or commonly referred to as 3D conformal radiation therapy in radiotherapy is a type of cancer treatment that uses radiation emission that is the same shape as the tumor to be treated or can be seen in 3-dimensional form. Using 3D conformal radiotherapy can make healthy tissue and surrounding organs will not affected by treatment, so it can reduce negative side effects.

3.2 QA TPS

Quality Assurance (QA) is having the main duties and responsibilities related to quality assurance or is solely responsible for ensuring products or services meet established standards including reliability, performance usefulness, and general quality standards set by the company. Quality assurance of the treatment planning system is to minimize the possibility of radiation

accidents. According to the IAEA (International Atomic Energy Agency) in Technical Reports Series, No. 430 explained that "specifically related to the tests and procedures performed, MP, modifications depend on the TPS owned or specific of the irradiation technique used in the department, and guarantee and confident (confident) The patient was irradiated as planned and there were no errors." The accuracy of the treatment planning system is 3% and radiotherapy treatment is 5%. Quality Assurance of the treatment planning system includes sparring organs, achieving the planned prescription dose, and target coverage. Step planning therapy is shown in Figure 1.



3.3 TPS COMPONENTS

The components of a treatment planning system consist of three important components which include:

1. Hardware. Hardware components consist of CPU, High-resolution graphics, mass storage (hard disc), disks / CD-ROM, keyboard & mouse, high-resolution graphics monitor, digitizer, laser/color printer, backup storage facility, and network connections.
2. Software. The software component consists of Input routines, Shape of anatomy, beam geometry, dose calculation, dose-volume histogram, and digital reconstruction radiographic. In the Radiotherapy Installation, Saiful Anwar Hospital uses software called Oncentra External Beam 4.5.3.
3. Image Acquisition. The image derived from the software is 3 dimensions.

3.4 TREATMENT PLANNING SCHEME

Before doing a treatment, the doctor must know about the patient's information first, and must go through various stages such as the Scheme figure 2.

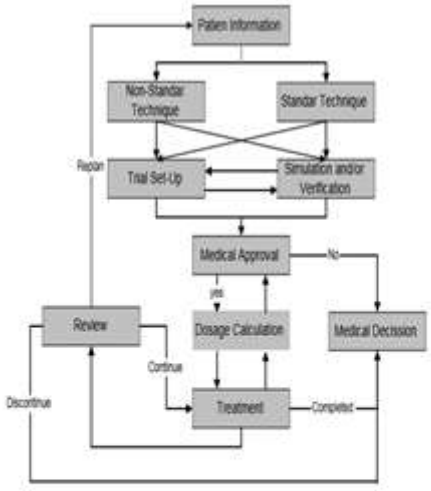


Figure 2 Scheme of planning and implementation of treatment (Leung, 1978).

3.5 DETERMINATION OF THE TARGET DOSE

After doing the stages regarding patient information (diagnosis given by the doctor or observation) then followed by planning or decisions taken in determining the treatment actions needed and forwarded to determine the position and immobilization of the patient then take photos that can be done using CT Scan, ultrasound or MRI which is used to see the target position to be taken (treatment). CT scan results that have come out will be processed and inserted on a CD which will then be processed by medical physicists to be portrayed using a computer (Treatment Planning System). The steps regarding drawing on computer programs or commonly

called Treatment Planning systems (TPS) are:

a. Opening the Oncentra TPS Program
   1. Turn on the CPU
   2. Transfer Files : Photos from the patient's CT Scan results will be transferred to a computer in the physics room using a CD / DVD for processing/contouring
   3. Open TPS software
   4. Log in to the software : Log in by entering the username and password on the TPS software.

b. Initial Planning Program
   1. New patient/patient data input from CT Scan
   2. Import patient CT Scan results
   3. Select a CT Scan result with the desired slice
   4. Filling in patient data
   5. Start contouring and planning

c. Reference Dosage Determination

Stage (4) is the contour process (depiction). The contouring process is divided into two, namely internal contouring and external contouring. Where internal contouring focuses on determining POI or Point of Interest. POI or Point of Interest is the ordination point (center point) of the target derived from the reference point on the CT Scan result or a point derived from three reference points that are interlocking (meeting each other). Reference points can be referred to as markers. External contouring focuses on determining ROI or Region of Interest. ROI or Region of Interest is to mark the organs around the target (OAR) and target volume (PTV, CTV, and GTV).

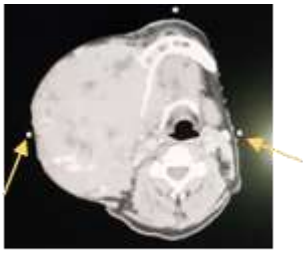


Figure 3. Reference Point

The determination or contouring of the GTV, CTV, PTV, and at-risk organs, is carried out by a radiation oncologist. ROI on OAR (organs close to the target and sensitive to radiation) covering the eye, spinal cord, and lens of the eye. After contouring the OAR, contouring the target area (GTV, CTV, and PTV) continued. Then proceed to determine the therapeutic dose used as a reference.

Radiation oncologists determine a DOSE of PTV of 30 Gy with details of 10 treatments with each treatment receiving a dose of 3 Gy. Then the reference dose for the eye is (Dmax < 28 Gy), for the lens of the eye (Dmax < 5 Gy), and for the Gy spinal cord (Dmax < 28 Gy).

d. Planning Beam

After the reference dose is determined, then followed by a planning beam to determine the direction of the beam. Memilih select activity

1. Enter the plan manager menu and select a new plan
2. Choosing a new beam
3. Set the formed beam

In the case of Ca-Thyroid, three directions of the beam are obtained, namely from the direction of AP (front), PA (back), and lateral (side). Then, there is a reset of the beam direction because the direction of the beam from the side direction hits the OAR of the eye and spinal cord so that the OAR part is closed using a block. This is so that the OAR continues to receive doses within safe limits so that it does not exceed the reference dose. After all OAR and targets receive the appropriate beam direction then proceed with dose calculation.

e. Dose Calculation
1. Choosing a dose calculation
2. Determining beam dose
3. Set beam weighting

4. Determining DVH and prescription dose
5. Consultation with a radiation oncology doctor

In the case of Ca-Thyroid with a reference dose of PTV which is 3 Gy, because there are three rays, each ray receives 1 Gy and a beam of the dose will be calculated automatically. But on the right cheek received an excess dose so it is necessary to reset the dose distribution by using beam weighting. After the dose distribution was set again, DVH and prescription dose were PTV of 2.92 Gy with a volume charged at 81.56%, CTV of 2.83 Gy (93.99%), GTV of 2.77 Gy (97.17%), the right eye of 2.01 Gy, left eye of 0.73 Gy, right eye lens of 0.45 Gy, left eye lens 0.19 Gy, and spinal cord 1.8 Gy. The dose received by OAR is the dose of each fraction. After obtaining a prescription dose (therapeutic dose) then consulted with a radiation oncologist, and if agreed to continue with treatment if not then reset the therapeutic dose.

4. CONCLUSION

Here are some conclusions that can be drawn, including:

1. TPS 3D CRT or Treatment Planning System 3D Conformal Radiation Therapy is a form of radiation therapy technique that is a picture of CT planning so that the isodose curve can be formed by TPS following the shape of cancer tissue.
2. Prescription dose or determination of therapeutic doses in organs around the target can be obtained from 4 stages, namely the initial TPS program, initial planning, planning beam, and dose calculation. Therefore, the overall dose obtained is the right eye gets a dose of 20.1 Gy, the left eye gets a dose of 7.3 Gy, the right eye lens gets a dose of 4.5 Gy and the left eye lens gets 1.9 Gy. Meanwhile, the spinal cord obtains a dose of 18 Gy. Ptv received a dose of 2.92 Gy with an exposed volume of 81.56%. Then, on CTV received a dose of 2.83 with an exposed volume of 93.99%. Then, the GTV received a dose of 2.77 with an exposed volume of 97.17%.

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