

Original Article: The Effect of Chemicals Used in Radiotherapy on Cancer

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ABSTRACT

Fortunately, with the advancement of medical science and early diagnosis of many types of cancer, we can hope for its complete treatment. Some believe that cancer is a disease that occurs mostly in elderly people. Although most of the time they are right, but many young people also get cancer. A large number of researchers around the world are working to find the best and newest way to treat cancer. Among these researchers, some of them are trying to reduce the medical and therapeutic wastes that cause the patients a lot of pain. One of the important side effects of radiotherapy is the destruction of healthy cells and damage to the skin, which causes secretions, wounds and skin necrosis. Currently, to prevent these wastes, doxang oxide cream or ointment is used, which has not been seen to have a good effect. Fortunately, there is a lot of information in modern and ancient medicine related to the healing properties of aloe plant, including the healing of skin wounds, burns, sunburn, and skin inflammation, which facilitates its use in modern medicine. Radiotherapy in high doses destroys cancer cells or slows their growth by damaging DNA. Cancer cells whose DNA has been damaged beyond repair will stop dividing and die. When damaged cells die, they are broken down and removed by the body. Radiotherapy does not kill cancer cells immediately. It takes days or weeks for the treatment to damage the DNA enough to kill the cancer cells. Then, cancer cells continue to die for weeks or months after the end of radiation therapy.

Introduction

Radiation therapy is one of the most important branches of medical physics. Radiation therapy refers to the treatment of diseases using penetrating rays such as X-rays, alpha, beta, and gamma rays, which are either radiated from a device or

emitted from drugs containing labeled substances. Almost half of people with cancer have experienced radiation therapy as part of their treatment plan [1]. Chemotherapy and radiation therapy are the most common methods of cancer treatment. Radiation therapy is also used to treat benign diseases and some thyroid diseases or some blood diseases. The

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purpose of radiation therapy is to deliver a certain amount of energy to cancer cells, and the transfer of this energy causes the ionization of the atoms that make up the cell and eventually destroys them. Radiation therapy may also damage healthy cells. Therefore, in radiation therapy, the correct control of the dose delivered to the target volume is the most vital program in the quality control of the radiation therapy unit, that is, the radiation dose should be controlled in such a way that it can have the most destruction in cancer cells with the least damage to healthy tissues. Radiation therapy is sometimes performed externally (when the device outside the body targets cancer cells) and sometimes internally (when the source of radiation inside the body is placed near the cancer cells). Both forms are used in the treatment of patients [2-4]. In this method, as a result of DNA damage, the cells of the treatment area (target tissue) are destroyed and the continuation of growth and division becomes impossible. Although radiation damages healthy cells in addition to cancer cells, most healthy cells recover. The goal of radiation therapy is to destroy as many cancer cells as possible with minimal damage to healthy tissues. The main application of radiation therapy is in the treatment or reduction of cancer diseases. The problems that may occur as side effects of radiation therapy during the treatment, although they are unpleasant, are often not acute or dangerous side effects and disappear with time (several weeks after the end of the treatment). The occurrence of complications depends on the method of treatment and the treatment area, the patient's body tolerance and the amount of radiation (radiotherapy dose) [5].

Many patients do not have any side effects during the treatment and easily go about their daily activities. Of course, general side effects may also occur during radiation therapy, such as fatigue, lethargy, and depression. Some of the complications that appear in these patients are

basically related to the general complications of cancer [6-8]. In any case, the care of patients undergoing radiotherapy includes general care, specific care and psychological care. Irradiation may be done by a device outside the body (external radiotherapy) or by a source of radiation inside the body (internal radiotherapy) or by open radioactive materials inside the body (systemic radiotherapy). The type of irradiation depends on the type of tumor, the tolerance of healthy tissues around the site, the distance that the radiation must travel inside the body [9]. It also depends on the general health of the patient, the history of the disease and whether the patient will use other methods of treatment or not and a set of other factors. In most of the patients, external radiation therapy method is used, and in some patients, three methods of external, internal, and systemic radiation therapy are used together or separately [10]. In recent years, with the advancement of computer science in the design of treatment, as well as accelerator equipment in the way of delivering the dose to the patient, the treatment has moved towards "Intensity Modulated Radiotherapy" (IMRT). In IMRT, each radiation field consists of a number of radiation subfields and a ray of different intensity is created. This treatment is especially useful for curved areas and when organs at risk are located in the vicinity of the tumor. Performing IMRT can be static, dynamic, IMRT with rotating cone beams, IMRT with rotating fan beams or zomotherapy [11].

When using the margin for the contour of different therapeutic volumes, it is necessary to pay attention to the fact that considering the margin too small may cause the loss of the tumoral area, and on the other hand, considering the margin too much can cause damage to healthy tissues. The use of "Imaging-guided radiotherapy" (IGRT) reduces such errors and increases the accuracy of treatment. Today, stereotactic radiotherapy (SRT) is used in

developed countries to eliminate inoperable tumors such as some brain tumors [12]. In this treatment method, the prescribed dose is usually given to the tumor for up to five sessions. The important point in this treatment method is the use of patient immobilization devices, which are usually related frames [13]. In this regard, we can mention "Cybernife", which is actually a stereotactic system in which the X-ray production source is installed on a robot and allows different angles to be obtained. The treatment in this method is based on 3D imaging, with the help of images, the tumor can be accurately identified. Cybernife can be used to treat small tumors with high precision. In addition to X-ray treatment, ion radiation such as protons can be used to destroy cancer cells. One of the important features of proton therapy is how to deliver the absorbed dose of these particles in the tissue. The percentage curve of the absorbed dose of this radiation in the tissue depending on the energy used has a maximum peak at a specific depth called the Bragg peak, which can deliver the highest dose of radiation to the tumor site [14-16].

In recent years, many advances have been made in the field of radiotherapy in Iran, but there is still some equipment related to advanced treatments. On the other hand, considering the significant statistics of cancer in the country, it is necessary to first have correct information about the rate of cancer. It should be noted that the use of registration systems based only on laboratory information (pathology) causes undercounting in cancer statistics, which is how statistics are recorded in Iran. Meanwhile, the cancer registration system of developed countries, in addition to collecting laboratory data, also collects clinical data and patient mortality [17]. Another factor that causes errors in cancer registration statistics is the population coverage of cancer registration; For example, population coverage in the United States is 99%, Australia and New Zealand 86%, and the

European Union 57%; While the amount of coverage in South and Central American countries is only 21% and in African countries and Asian countries it is 11% and 8% respectively (1). Therefore, it seems that in our country, a correct registration of cancer should be done first, and then based on the needs assessment of different regions, regarding the establishment and equipping of radiation therapy centers, action should be taken. Aloe vera is a leafy and succulent plant that is known for its medicinal properties and its role in cancer treatment is investigated. Let's see what the research has to say (Figure 1). Aloe plant - native to Africa - belongs to the lily family and is a common household plant in many countries. Among this family, one of the most well-known is Aloe vera.

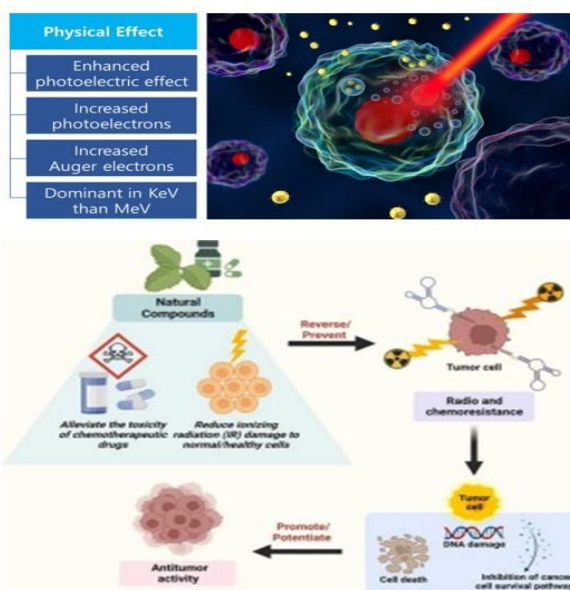


Figure 1. Natural products as chemo-radiation therapy sensitizers in cancers

Its leaves are thick and dark green, fleshy and look like a cactus. Its leaves contain a light and thin gelatinous substance that oozes from the fleshy part of the leaves [18].

- Aloe vera gel is used directly to relieve skin related problems such as burns, sunburns, cuts, scrapes, wounds, etc.

- Due to its soothing properties, it is also present in many skin and beauty products. They also drink its juice.
- The extract that comes out of the outer cover of the leaf is a bitter yellow liquid called aloe latex, which is dried and turned into brown pollen and used to treat constipation.
- Aloe vera is also claimed to help maintain immune levels and destroy cancer cells. However, there is no conclusive scientific evidence in this regard.

The researches listed below are studies that have been conducted to investigate the role of aloe vera in preventing or treating cancer [19].

Using aloe to investigate the side effects of cancer treatment

Aloe vera has always been used in traditional medicine in the form of topical gel to treat skin burns and cuts. In the 1930s, it was used to treat skin reactions caused by radiation therapy. However, recent studies in this field have reached a different conclusion. Research was conducted to investigate the effects of aloe vera gel on skin reactions caused by radiation when applied directly to the skin. The researchers conclusively proved that there is no such evidence proving the role of aloe vera in reducing skin reactions due to radiotherapy [20].

A 2004 trial that looked at whether aloe extract helped treat mouth ulcers caused by radiation from head and neck cancer concluded: The extract did not help at all. More studies are needed to investigate the role of aloe vera, whether it really helps to relieve cancer or not.

Aloe vera can help reduce dryness around the skin and soften it during recovery. Preliminary research supports the fact that

it may be effective in wound healing. However, it is always best to consult your doctor before substituting aloe vera for standard cancer treatment (Figure 2).

Some people advocate the theory that aloe helps and strengthens the body's immune system by directly attacking foreign cells, thus curing cancer. This is thanks to the immune stimulatory feature due to the content of acemannan - a mannose polysaccharide - in it. It is thought that celandine increases the activity of macrophages and releases helpers of the immune system, thereby aiding in the treatment of cancer. Studies have shown that acemannan can stimulate the immune cells of mice to produce cytokines (cancer-killing proteins) [21].

Another test-tube study showed that aloeride—a starchy component of aloe juice—acts as an immune stimulator, thereby producing cancer-fighting chemicals.

It has been determined that a compound made from aloe vera - di(2-ethylhexyl) phthalate (DEHP) - prevents the growth of leukemia cells (blood cancer). However, this is a preliminary study and not much can be said about it at this time (Figure 2).

Two studies conducted in 2010 on mice investigated the role that aloe could play in the treatment of skin cancer. In one study, it was concluded that aloe products applied to the skin or taken orally helped to shrink cancer cells. However, the second study yielded negative results; Thus, some aloe products increased skin cancer cells.

The studies conducted on the test tube containing Emodin Aloe - an extract from this plant - showed that it can stop the growth of head and neck cancer and liver cancer cells. As a result, it indicates the fact that it has the potential to treat cancer [12].

In a study conducted in 2007 (this research was conducted at Wilkes University), it was announced that aloe vera can prevent the growth of cancer cells composed of carcinogenic substances, and as a result, its anti-tumor properties are determined. In 2009, during a trial, aloe vera was tested along with chemotherapy for patients with metastatic cancer (lung, colon and stomach).

The results showed that for a certain period, cancer cells were reduced in size in 67% of patients who used aloe vera along with chemotherapy. While such a result was obtained in 50% of people who only underwent chemotherapy. In all the mentioned studies, the researchers recommend that more research should be done to confirm or reject their findings [3].

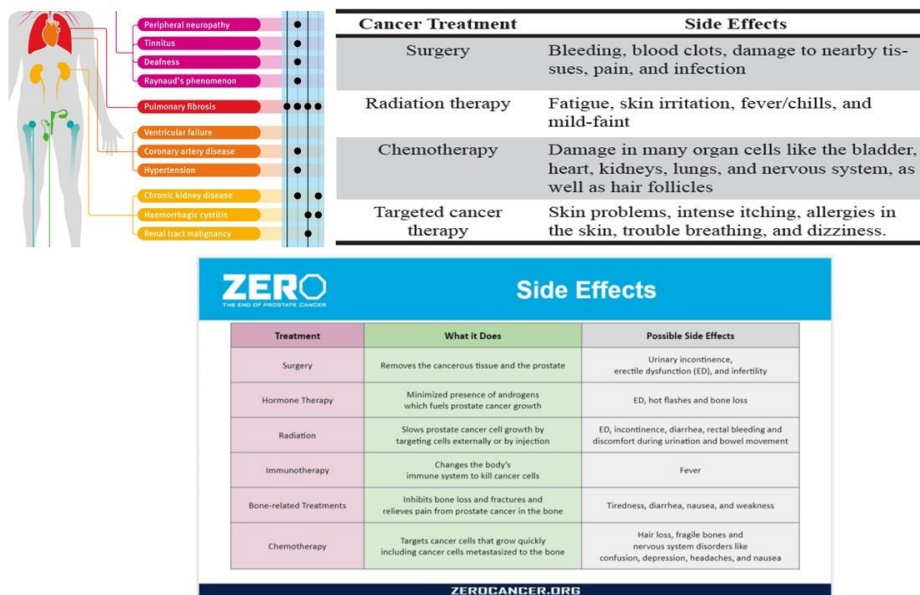


Figure 2. Effects of cancer treatment

However, aloe vera has not yet been considered as a medicine for cancer treatment. In research, the use of aloe vera has been emphasized, especially some compounds of this plant that have anti-cancer effects. Aloe vera shows a wide range of therapeutic properties, including anti-inflammatory, antimicrobial, antiviral and antioxidant properties. Aloe vera gel is used topically to heal and soothe skin wounds/abrasions, minor burns, sunburns, radiation skin damage, psoriasis-related skin conditions, acne, dandruff, and skin hydration. The gel helps soothe inflamed skin. It contains sterols that can boost the production of collagen and hyaluronic acid, which may help rejuvenate the skin and improve skin texture, thereby reducing the appearance of wrinkles [4].

Side effects of aloe vera juice

Despite the potential benefits mentioned earlier, oral consumption of aloe vera juice is associated with many side effects, including:

- ❖ Constipation and diarrhea - if the extract contains large amounts of aloin, a compound found between the outer leaf of the aloe vera plant and the gel inside, which has laxative effects.
- ❖ Nausea and vomiting.
- ❖ Low potassium level when consuming aloe vera juice along with chemotherapy.
- ❖ Aloe vera toxicity leads to seizures and electrolyte imbalance.
- ❖ Interference with drugs that are substrates of cytochrome P450 3A4 and 2D6.

What are the side effects of radiotherapy in breast cancer patients?

Radiotherapy is a treatment method in which certain types of radiation are used in the treatment of malignant diseases. In radiotherapy, high-energy rays are used to destroy cancer cells. These beams are usually produced by a device called a linear accelerator. For this purpose, the patient sleeps on the accelerator bed, and then the rays from different angles previously determined by the medical group; It is radiated to the bed of the disease. The rays have no color or smell and cannot be seen by the eye. It should be noted that these rays do not heat or cool the body [5].

What are the complications of radiotherapy in breast cancer?

Radiation therapy and radiotherapy can have two types of complications, which are:

1. Acute complications of radiotherapy

Acute complications occur during radiotherapy and up to several weeks after radiation therapy. These complications include skin problems including redness, dryness, sensitivity and itching of the skin and discoloration of the treated area, stiffness in the surgical site, weakness and lethargy, nausea, cough and shortness of breath, and rib pain [6].

2. Late complications of radiotherapy

which usually occur several months after the completion of radiotherapy and include skin complications, lymphedema, and cardio-pulmonary complications. Cardio-pulmonary complications are usually rare and, in most cases, do not cause special problems for the patient. In short, lymphedema refers to the accumulation of fluid in the interstitial space in any part of the body, and a disturbance in the

structure or function of the lymphatic system for any reason can cause lymphedema, which will lead to swelling in the affected area [7].

Most of the patients' problems during radiotherapy are skin complications, and the following are recommended to control and improve them:

- Keep the skin clean.
- Bath with lukewarm water.
- Use shampoo or baby soap while bathing.
- The skin of the treatment area should be cleaned gently by hand and do not use a bag or cloth.
- After bathing, a soft towel should be gently placed on the skin and removed, and avoid pulling the towel to the surface of the skin.
- Do not use a hot water bag or an ice pack on the treated area.
- Avoid scratching the skin.
- Do not expose the skin to direct sunlight.
- Ointments recommended by the attending physician should be used [28].

Palliative radiotherapy

Sometimes the disease may recur and if the severity of the symptoms is not reduced with different treatments, it affects the patient's quality of life. For example, if the recurrence is at the site of the previous surgery in such a way that complete surgery is not possible, radiation therapy or palliative radiotherapy can be used (Figure 3). If the disease spreads to the bone or bone marrow, radiation therapy to these areas is helpful to prevent the disease from progressing [19].

Palliative Radiation Therapy

- Hypofractionation
- **One day to two weeks.**
- **Treat: Only site requiring palliation.**
 - Forego areas at risk for subclinical or asymptomatic cancer.
 - May purposely miss known areas of tumor.
- Goal is **relief** of symptoms.
- **Less concern about long term** side effects.

Figure 3. Palliative radiotherapy

Brain tumor treatment with radiation therapy

Brain tumor is very sensitive and dangerous due to its proximity to the brain. Therefore, in general, people who are neurologists use two methods for treatment. The first method is brain tumor surgery. Surgery has many problems and difficulties and sometimes it is not suitable for some people. Therefore, radiation therapy specialists use another method to treat brain tumors. This method is called radiation therapy or radiotherapy, which indirectly deals with brain tumor treatment.

Types of radiotherapy and radiation therapy methods

There are several types of radiotherapy and radiation therapy for brain tumor, which include:

IMRT radiation therapy for brain tumor treatment

IMRT is a three-dimensional radiation therapy method and is relatively developed. Using this method, a specialist uses a computer to emit radiation therapy waves around the patient. Among the advantages of this method is targeting the rays, determining the radiation angle, determining the type of rays and the intensity of the rays, which greatly helps the

treatment process. Nowadays, IMRT method is considered one of the most effective methods for brain tumor treatment.

STREOTACTIK radiation therapy for brain tumor treatment

STREOTACTIK method can be done in two ways. In the first type, a strong dose of radiation is irradiated to the tumor area. This procedure is done in one session and it is also called radiation surgery. In the second type, the same high dose is irradiated to the tumor area, but the main difference is that this is done in several sessions, not all at once. Spindle type of treatment is also called radiation therapy. Note that the STREOTACTIK method is more accurate than other methods and causes much less damage to healthy brain tissues [10].

Proton radiation therapy for brain tumor treatment

In this method, proton beam is used instead of X-ray. Proton causes less damage to healthy tissues than X-ray. In fact, the side effects of brain radiation therapy are very limited, and this is the advantage of this treatment method over methods such as surgery. Proton radiation therapy is recommended by a brain tumor doctor. It is worth noting that there may be other types of methods to treat brain tumor with radiotherapy. Radiotherapy for brain tumor has

its own advantages and disadvantages. In this article, we only reviewed the most important and best treatment methods. Naturally, the choice of treatment method is the responsibility of the specialist doctor and is determined after examination and various tests.

Problems caused by radiotherapy and brain tumor radiotherapy

Although the radiation therapy method is very useful and efficient, it also has its side effects that are sometimes troublesome. These problems increase in malignant brain tumor radiation therapy compared to benign brain tumor radiation therapy. Among the problems caused by this method of treatment are:

- The speed of treatment is slow. As a result, controlling the tumor and inhibiting its growth takes months or even years. Therefore, this treatment can be considered a winding path that requires a lot of time and patience.
- It endangers the health of the healthy tissues around the pituitary gland. Most all radiation therapy methods damage the healthy tissues around the brain tumor and only the intensity of this damage is different in different methods.
- This method may cause disorders in the optic nerve of the person and even blind the person being treated [1].

Complications of brain tumor radiotherapy

Brain tumor radiation therapy, like anything else, in addition to the benefits it brings to the patient, also causes complications in them. Among the side effects of brain tumor radiation therapy are:

Weakness and lethargy after radiation therapy

Many people who do radiation therapy are weak and lethargic after a few days of doing it. Even in the continuation of the treatment process, its

intensity increases. This weakness and lethargy is not permanent and gradually improves. Paying attention to the diet is one of the most important points in getting better.

Hair loss and thinning in radiation therapy or radiotherapy

Hair loss in brain radiotherapy is another common problem that many people who undergo radiation therapy suffer from. This problem is caused by the passage of radiotherapy rays through the hair. Hair regrowth in those areas depends on the type of radiation therapy and the intensity of the radiation [32].

Feeling sick during radiotherapy

Feeling sick after radiation therapy sessions is a common and very normal thing and can be easily controlled by taking pills and medicine.

Worsening of brain tumor symptoms

Sometimes we see that radiation therapy for a brain tumor backfires and the brain tumor gets worse instead of getting better. The main reason for this is brain swelling caused by radiotherapy, which even causes severe headaches and convulsions in a person.

The effect of radiation therapy on brain function

Effects on brain function is one of the rare and long-term side effects of radiotherapy. This complication is very rare and rare, but still there is a possibility of its occurrence. During this condition, the person experiences constant dizziness, his memory deteriorates and it becomes very difficult for him to do some simple tasks.

Changing hormone levels with radiotherapy and radiation therapy

Sometimes radiotherapy causes changes in hormones. This factor is especially noticeable when radiation therapy is performed near the pituitary gland.

Body slimming in radiation therapy

People who undergo radiation therapy lose weight during their treatment. The main reason for this factor is X-ray radiation to the patient's body. In this section, we learned about the effect of radiation therapy on brain tumor and learned about different types of side effects of radiation therapy. It is worth mentioning that some complications are common and not worrying. But some other complications can cause serious problems in a person's daily life.

Radiation therapy in Iran

This treatment method has been performed by specialist doctors of our country in different cities for several years. Therefore, if you have a brain tumor, you don't need to travel abroad for radiation therapy because the same thing is done with the most advanced devices and by skilled doctors in Iran itself. Other side effects of radiotherapy include:

Fatigue

Complications are usually in the area where the treatment is performed. There are some general side effects such as: Feeling tired and weak. You may feel tired during the treatment, due to the stress caused by the disease, the effect of the radiotherapy treatment or the long period of waiting, repeated daily visits. This condition is temporary and disappears after the end of the treatment.

- Try to rest more.
- Increase your sleep time at night and rest during the day.

- You can continue your daily work, but you should not impose heavy tasks on yourself that you are not capable of.
- Doing light sports such as walking and gentle exercises can help reduce fatigue caused by radiotherapy.
- Nausea and vomiting
- Anorexia
- Skin problems.

To reduce skin complications, pay attention to the following points

In cases where the oncology radiotherapy specialist prescribes a special lotion or cream and ointment for you, use it on the same day and in the same amount and method as prescribed. The best time to use is preferably immediately after each session. So that no cream remains on the treatment area at the next visit. Arbitrary use of ointments or hair restoration lotions can worsen your skin condition.

- Changes in blood cells;
- Emotional problem.

The stages of cancer treatment with radiotherapy are as follows

First step: Meeting with the doctor and discussing radiotherapy treatment methods. To determine the treatment method, all the information about the type of cancer and the disease is received and a medical file is created. At this stage, cancer screening, CT scan and MRI or sampling are performed to determine exactly what stage the cancer is in and in which areas of the body.

Second stage: At this stage, the exact location of the tumor in the patient's body is determined and the contouring of the organs at risk is done so that the necessary care is taken to minimize the amount of damage to the organs close to the cancer site.

Third stage: At this stage, the maximum dose of radiation is determined to destroy cancer cells

and shrink tumors. Also, to minimize damage to other organs, a minimum dose is determined.

The fourth stage: At this stage, the radiotherapy sessions will start and you will also have consultation with the doctor during the treatment sessions. Each radiotherapy session usually lasts 30 minutes with prior preparation and positioning of the radiotherapy site. In general, depending on the physical condition and the disease, as well as whether radiation therapy is the only treatment method selected or combined with other treatment methods, between 3 and 5 sessions per week are considered.

The fifth stage: At this stage, after 8 weeks of radiotherapy, screening tests (CT, MRI), biological blood tests and clinical examination are performed to check the results of radiation therapy on the patient to determine the continuation of the treatment.

Will he perform tests during the radiotherapy and radiation treatment sessions? During the procedure, you may need occasional blood or urine tests. It depends on the part of the body that is being treated. These tests are a routine part of the treatment program and there is nothing to worry about [3].

Is there pain during radiotherapy sessions?

No. Radiation therapy is completely painless and the rays cannot be seen or felt.

What is the number of radiotherapy sessions? The decision on the length of the treatment period is the responsibility of the doctor and is determined according to the results of the screening and examinations. Therefore, it is not possible to give an exact number about the number of sessions, but usually the number of treatment sessions can be between 3 to 5 sessions per week and continue for 6 weeks or more. The stopping time is determined by the doctor according to the test results.

How long does each radiotherapy session last? According to the type of device and the type of radiation therapy that the doctor prescribed for you, the time of each session is different. The length of a radiotherapy treatment session can be from 5 minutes to 15 minutes or more. In the first session, the length and duration of the sessions will be announced to you (Figure 4).

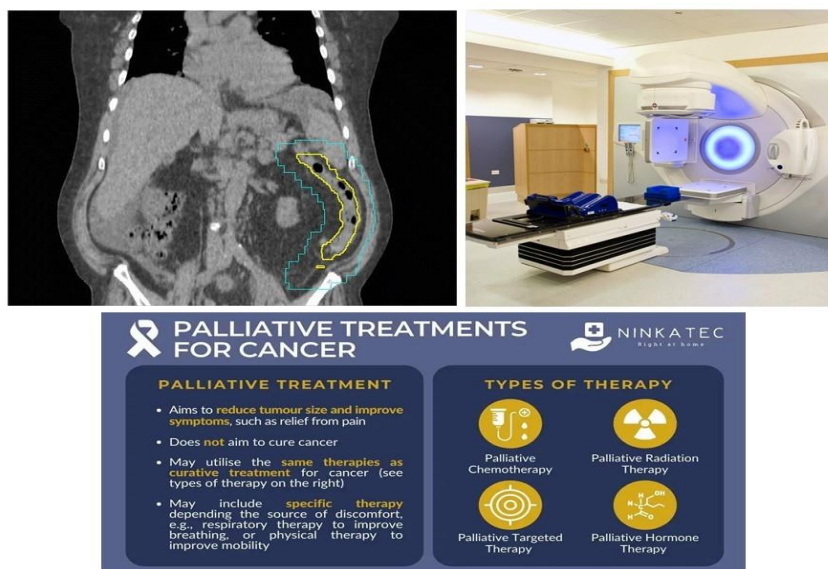


Figure 4. Radiotherapy Process

Types of radiotherapy

➤ Internal

Radiotherapy is a type of treatment in which the radiation source is placed inside the body. A type of internal radiotherapy is called brachytherapy. In brachytherapy, the source of radiation is solid and is in the form of beads, strips or capsules that are placed in the body in the cancerous area or around it. This method makes it possible to deliver a larger dose to a smaller and more limited part of the body. Internal radiation can be in liquid form. Liquid radiation can be by drinking it, swallowing a pill or intravenously. The irradiated liquid circulates in the body in search of cancer cells and destroys them. Brachytherapy can be used for people with head and neck, breast, uterus, cervix, prostate, gall bladder, esophagus, eye and lung cancers. Internal radiation therapy liquid type is usually used for people with thyroid cancer and non-Hodgkin's lymphoma. Also, the patient may be treated with internal radiotherapy along with other treatments, including external radiotherapy, chemotherapy and surgery. The patient meets the doctor before the treatment. In these meetings, he will be examined and photographed, and a history will be taken from him. The doctor explains to him the most suitable method in internal radiotherapy, the complications and benefits, and the necessary care during and after the treatment. The patient can choose to undergo this treatment or not [4].

➤ External

In this radiography method, radiation is emitted from a device towards the tumoral area. This device is big and may make some noise. The device does not touch the patient's body, but it rotates around him and in this state, it radiates radiation from different directions to the patient's body. Radiotherapy is a local treatment. This means that the beam shines only on a certain part of the body. For example, if the

patient has lung cancer, the radiation is only directed to the chest and not to any other part of the body.

Is radiotherapy expensive?

Yes. This treatment is expensive. Because complex devices are used and many people are involved in the therapy team. The exact cost of radiotherapy depends on the cost of the treatment team, where the person lives, its type and the number of treatments he needs. But in fact, it is a small amount to reach the health again and heal the patients.

Do you have to follow a special diet during radiotherapy?

During radiotherapy, the patient's body spends a lot of energy for regeneration and recovery. It is very important that enough calories and protein reach the patient's body to maintain his weight at that time. He should ask his doctor or himself about the need to follow a special regimen during radiotherapy. Talking to a nutritionist can help.

Can the patient go to work during radiotherapy?

A group of people can work full time during radiotherapy. Other people may be able to work part-time or not at all. The amount of a person's ability to work depends on his situation and feeling. It is better to ask your doctor what to expect. A person may be able to work and have a good condition when starting radiotherapy. But over time, you should not be surprised to feel more tired, less energy or weak. It takes a few weeks to a few months after the treatment to improve the patient's condition. During radiotherapy, the patient may reach a point where he feels so sick that he cannot work. For this reason, it is better to talk to his employer about sick leave and make sure that the

insurance pays for the medical expenses while he is on leave [5].

Which is better radiation therapy or chemotherapy?

Now that we have checked the success rate of radiation therapy to some extent and the parameters affecting it have been determined, it is better to talk a little about the difference between these two treatment methods. Radiation therapy is a type of local treatment. In fact, in this method, cancer cells that are involved in a specific position are destroyed. It is evident that the percentage of success of this treatment is higher than other methods because it poses fewer risks to healthy cells. In the chemotherapy method, medicine is used and the medicine gradually enters the blood and covers all parts of the body. Finally, it will destroy the part that has cancer cells. Radiation therapy and chemotherapy target cancer cells. With the difference that in the radiation therapy method, only the location that has cancer cells is involved, and other locations remain untouched. The success rate of radiation therapy is higher when cancer cells have not yet surrounded all parts of the body. If cancer cells have reached most parts of the body, chemotherapy will be needed. If certain parts of the body are involved in cancer cells, radiation therapy can be more effective and is considered the best option.

In order to check whether radiation therapy or chemotherapy has a higher success rate, we must look at the side effects of each method. Chemotherapy side effects are much more than radiation therapy. For example, one of the most common side effects caused by chemotherapy is hair loss, which is painful for many patients, especially women, and causes them to lose their self-confidence. Other side effects caused by chemotherapy are unpleasant skin changes, for example, spots, sagging and wrinkles are felt on the skin. Therefore, it is clear that the success rate of radiotherapy is very high. In order to

understand the success rate of radiation therapy compared to chemotherapy, we need to examine a series of cases carefully. For example, radiation therapy may be prescribed after chemotherapy. This method is used to eradicate cancerous tissues, and generally the transmission of radiation will be in a certain range. The success rate of radiation therapy depends on the type and size of cancer tumors. Radiation therapy has nothing to do with healthy body tissues and identifies cancer cells and destroys them. The main goal of radiation therapy is to destroy the tumor or shrink it. In fact, in this method, the symptoms of cancer are greatly reduced. If we want to check the success rate of radiation therapy based on the level of side effects, it seems that there is some deep burn and burning and itching in this method, but it can be solved with the help of the doctor.

In evaluating the success rate of radiation therapy, it is clear that it is usually better to do it during surgery, so that as soon as the tumor tissue is removed, radiation therapy with a high dose is introduced to the surgical site, and finally, this approach causes the risk of recurrence. The tumor is also reduced. One of the most common side effects of radiation therapy is skin redness or irritation. In fact, you need to be gentle with your skin after radiation therapy. If you have nausea, you can contact your doctor so that the necessary explanations will be given to you. The success rate of radiation therapy is much higher when the cancer cells are not too many and have not covered the whole body. If there are many cancer cells, radiation therapy and chemotherapy are needed.

3D conformal radiation therapy (3D-CRT)

Tumors have different shapes and sizes. Conformal 3D radiation therapy or 3D-CRT uses software technology and special imaging techniques to show the size, shape and location of the tumor. In this method, in the first step, a special type of CT scan is performed for all

patients in conditions exactly similar and reconstructed from the conditions during treatment. This type of CT scan is called CT simulation. The radiation therapy team uses CT simulation to plan the treatment, determine the exact location of the mass, and determine the dose distribution. During the CT simulation, the patient is completely immobilized by special equipment. This equipment is used throughout the treatment so that the treatment is always performed in conditions similar to the CT simulation conditions on which the patient's treatment is designed. Also, other imaging methods such as MRI (MR or MRI scans) or positron emission tomography (PET scans) may be used to obtain three-dimensional images with more details of the tumor and surrounding areas. Using these images, the radiotherapy specialist can precisely adjust the rays according to the size and shape of the patient's tumor. Because the beams are very precisely directed, the normal tissues around the tumor receive less radiation and are less damaged. As a result, they will be able to recover faster.

Image-guided radiation therapy (IGRT)

Tumors move during treatment (due to differences in the filling and emptying of body organs such as the bladder or movements of the body and organs during breathing). Therefore, radiotherapists use IGRT, or image-guided radiation therapy, to deliver more precise radiation to cancer cells. IGRT is a type of 3D conformal radiation therapy. In this technique, the imaging capability such as CT scan or graph is built into the radiotherapy machine. Therefore, an image of the patient's body is prepared in the treatment room just before radiation therapy. In this method, CT simulation is performed for all patients first as part of the treatment process. Then the imaging information obtained from the CT simulation is transferred to a computer in the radiation therapy room, then the doctor compares the

image prepared in the radiation therapy room with the CT simulation images in each session. If these two images do not match before starting the treatment, the position of the body may be modified several times so that the patient is in the right position and the treatment is performed only if the image prepared in the treatment room matches with Imagine a CT simulation. The purpose of these measures is to target the cancer cells much better and more precisely and to minimize the damage to the healthy tissues around the tumor. In some cases, the doctor places a small mark called a marker in or near the tumor to determine the exact spot of radiation for IGRT.

Intensity Modulated Radiation Therapy (IMRT)

Intensity modulated radiation therapy or (IMRT) is a special form of three-dimensional conformal radiation therapy (3D-CRT) that allows radiation to be very precisely tailored to the shape and size of the tumor. Using IMRT, the beam can be broken into many micro-beams and in this way the intensity of each beam can be adjusted individually. By using radiation therapy with modulated intensity, we may be able to limit the amount of radiation received by the healthy tissues around the tumor. In some situations, it is even possible to deliver higher doses of radiation to the tumor and thus increase the chances of the patient's recovery.

Stereotactic radiotherapy

Stereotactic radiation therapy is a technique that allows the doctor to precisely focus the radiation on cancer cells during radiation therapy. Due to the high accuracy of this technique, damage to healthy tissues will be minimized. This very high precision in stereotactic radiation therapy is created by using advanced immobilization method (such as head holding devices used in the treatment of brain tumors). Stereotactic radiation therapy is often administered in five

doses. In addition to treating some cancers, stereotactic surgery can also be used to treat brain blood vessel abnormalities and some non-cancerous (benign) neurological diseases. Stereotactic radiation therapy is also used to treat tumors outside the brain. This method of treatment is called stereotactic radiation therapy of the body [7].

Systemic radiotherapy

Some cancers may be treated by taking pills or receiving intravenous radioactive injections. This method of treatment is called systemic radiation therapy. Because the drugs in this method are spread throughout the body, drugs such as radioactive iodine (I-131) capsules, which are prescribed to treat some types of thyroid cancer or intravenous radioactive substances that are used to treat pain caused by bone involvement. Antibodies attached to radioactive particles directly bind to cancer cells and thus attack the cancer cell.

Radiation sensitizers

Any drug that can sensitize tumor cells to radioactive radiation is called a radio sensitizer. Combining radiation therapy with radio sensitizers can allow doctors to kill more cancer cells. Some types of chemotherapy and some targeted therapies can act as radio sensitizers.

Intraoperative radiotherapy

When the vital organs of the body are very close to the cancerous tumor, radiation therapy during surgery will have a very good result in the treatment of the person. In this method, during surgery, the surgeon temporarily removes the organs around the tumor from the path of radiation so that he can focus the radioactive rays directly on the cancer cells of the tumor [39]. This allows the oncologist to prevent vital organs from being exposed to radioactive rays. Radiation therapy during surgery can be done in

the form of external radiation therapy or brachytherapy.

Conclusion

Cancer is one of the most complex diseases that humans have dealt with throughout history. The reason for the complexity of this disease is that cancer is ahead of evolution and human science has not yet been able to fully understand it. There is still no definitive cure for all types of cancer. Of course, there are ways to treat cancer that are effective in many cases and lead to complete recovery. In radiation therapy, high-energy rays are used to destroy cancer cells or limit their growth. Sometimes radiation therapy is used only to reduce the symptoms of cancer and improve the patient's condition. In addition, radiotherapy is used to shrink tumors before surgery. The oncologist together with the radiotherapy specialist examine the possibility of using radiation therapy for the patient and if they find the treatment effective, they use different methods to treat the patient or improve his symptoms. Some patients are worried about the complications and risks of radiation therapy. For more than 100 years, the use of radiation therapy has been a successful method for treating patients, and since then, many advances have been made to ensure the safety and effectiveness of radiation therapy [8]. Before radiation therapy begins, the oncology team carefully adjusts your treatment plan to ensure that you are treated with high precision and safety. The treatment process will be carefully planned to protect the healthy tissues around the tumor and to focus the treatment on the tumor and cancer cells. During the course of your treatment, the members of the medical team will repeatedly review your treatment plan according to your condition at each stage. If you receive external beam radiation therapy, you will no longer be exposed to radiation after each treatment session. Because these rays do not remain in your body. This means that after the

treatment is completed, radiation will not be emitted from your body to other people and the surrounding environment.

Some patients worry that radiation therapy itself may cause cancer years after treatment. While this is a very small risk, it is now the most important issue in current cancer treatment. You can talk to your radio oncologist about any fears or concerns you may have. Like all treatment methods, radiation therapy can have side effects. Radiation therapy is usually well tolerated by the patient and many patients are able to return to their normal routine after this treatment. However, some patients may end up experiencing side effects. It is necessary for the patient to talk to a member of his treatment team about any problem or discomfort that has happened to him. Most of the side effects of radiation therapy occur only in the part of the body that is treated.

For example, a patient with breast cancer may notice burning of their skin (like a mild to moderate sunburn), while a patient with oral cancer may have pain when swallowing. Some patients who received radiation therapy in the middle part of the body may feel pain in their stomach. These side effects are usually temporary and can be treated by your doctor or other members of the treatment team. Side effects usually occur in the second or third week of treatment and may continue for several weeks after the last radiation treatment session. In some rare cases, serious side effects develop after the end of radiation therapy for the patient. The oncologist and nurse are the best people to guide the patient and the patient's family about the side effects that the patient may experience. It is necessary for the patient to talk to these people about any side effects they have. These specialists can provide information on how to manage and treat complications and may prescribe medications or changes in a person's eating habits to relieve these complications. The side effect most often reported by patients who

have undergone radiation therapy is weakness and fatigue. Patients' fatigue is usually not severe, and patients can continue all or some of their normal daily activities at a reduced volume. Many patients worry that their radiation therapy will cause another cancer. In fact, the risk of developing a secondary tumor due to radiation therapy is very low. For many patients, radiation therapy can cure cancer completely and definitively. This very important benefit and achievement is far outweighed by the very small risk that radiation therapy can have in the possible development of subsequent cancer. If the patient smokes, the most important thing he can do to reduce the risk of secondary cancer is to quit smoking.

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