



Breast Cancer- Detection and Treating with Radiation

Prepared by:

Abdullah A. Kareem

Raman S. Abdulrahman

Supervised by:

MSc .Jala M.Ahmad

Table of contents

Contents

Introduction	1
Radiation	Error! Bookmark not defined.
Radiation falls into two main categories:.....	Error! Bookmark not defined.
Radiation comes in two forms:	Error! Bookmark not defined.
There are several types of ionizing radiation:	Error! Bookmark not defined.
Breast Cancer	3
Symptoms of breast cancer	3
How is breast cancer diagnosed?	3
• Clinical examination	3
• Imaging	4
A-Mammogram.....	4
Is a low-dose x-ray that looks for early breast cancers, by placing breasts separately on X-ray machine and pressed between two plates to produce clear images. If a mammogram Screening reveals anything suspicious in breast tissue, the doctor investigates further.	4
B-Ultrasound.....	4
C-MRI.....	4
• Biopsy	4
Breast cancer Staging.....	5
Types of breast cancer	5
1-Non-invasive breast cancer.....	5
2-Invasive breast cancer.....	5
• <i>Angiosarcoma</i>	6
How breast cancer is treated ?.....	6
Who treats breast cancer?	Error! Bookmark not defined.
Surgery	7
The aim of breast cancer surgery is to:	7
Main types of surgery	Error! Bookmark not defined.
Side effects of breast-conserving surgery include.....	Error! Bookmark not defined.
Breast reconstruction	7

Hormonal Therapy	8
Chemotherapy	Error! Bookmark not defined.
Radiotherapy	9
There are two types of radiotherapy:	Error! Bookmark not defined.
1. Internal beam radiotherapy	Error! Bookmark not defined.
2. External beam radiotherapy	Error! Bookmark not defined.
The process of external beam radiotherapy	9
There are 3 types of beams used in radiotherapy	9
Photon beam.....	9
Proton beam	10
Electron beam	10
External radiation therapy machines.....	10
Statistic.....	11
Result	14
Discussion.....	15
References	17

Abstract

Breast cancer is the second most common cancer in women after skin cancer, according to European and American studies, in every eight women one is at risk of infecting by breast cancer, it occurs in both men and women but more common in women, there are many types of breast cancer but the Ductal carcinoma in situ (DCIS) is the most common and it was named by this name because it starts within the milk ducts, %90 of cases are this type of breast cancer.

The breast cancer is detected by 4 ways, including (Clinical examination, Imaging, and Biopsy). And there is number of options in treating it, your doctor will offer you according to a number of factors such as stage of cancer, location of tumor, and size of tumor.

Breast surgery is the most common treatment used to treat breast cancer in which a part of or whole the infected breast is removed, chemotherapy is another type of treatment in which medicines are used to kill cancer cells, and radiotherapy is another way to treat cancer tumors including breast cancer.

In the radiotherapy the targeted area where the tumor is located is bombarded with beams of high energy radiation to kill cancer cells and making them unable to recover themselves and they lose their ability for division and spreading by affecting genetic materials of them.

In this article we will discuss ways of breast cancer detection and treatment, which is mostly used, which is more safety and useful, and we will show a statistic of affected persons with breast cancer during a year in Zhianawa Cancer Center , and which type of treatment is used to cure their disease.

Introduction

The human body consists of billions of cells. These cells during life grow, divide as needed, and the cells will damage or die when they are in an abnormal status or when they get old. This process is called cell cycle.

The cancer will start when some things in this process go wrong and the cells keep making new cells while the old or abnormal cells don't die when they should. When these abnormal cells (cancer cells) grow out of control they can destroy normal cells.

Breast cancer is the second most common cancer in women after skin cancer, according to European and American studies, in every eight women one is at risk of being infected by breast cancer, it occurs in both men and women but is more common in women. There are many types of breast cancer but the Ductal carcinoma in situ (DCIS) is the most common and it was named by this name because it starts within the milk ducts, 90% of cases are this type of breast cancer. (1)

Breast cancer can originate in different parts of the breast. Breast cancer is divided and named according to the affected part, such as:

- Lobular cancer.
- Ductal cancer.
- Paget disease of the breast.
- Phyllodes tumor.
- Angiosarcoma

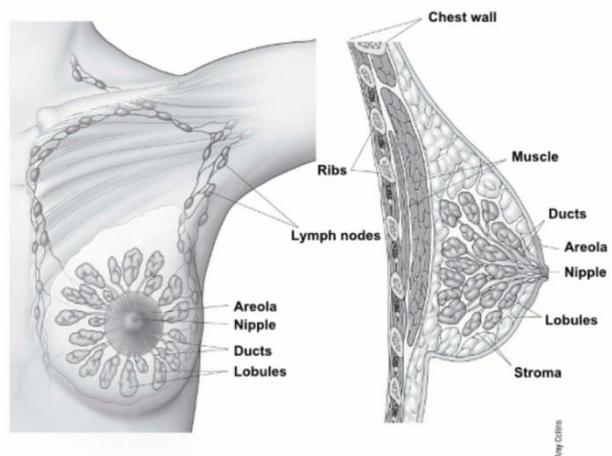


Figure (1): Parts of breast tissue

More than 14 million new cases of cancer are diagnosed each year worldwide; radiation therapy (RT) has Potential to improve cure rate for 3.5 million cases and have palliative effects provided relief to an additional 3.5 million people. This conservative estimate is based on the fact that about 50% of cancer patients can benefit from radiation therapy to manage their disease.

Soon after Roentgen discovered X-rays in 1895, ionizing radiation was used to the effect of treating cancer and the result was remarkable. Carefully Controlled Dosage of ionizing radiation damages DNA in cells, provides preferential acts on cancer cells compared to normal tissues, thereby saving lives and providing benefits in curing most types of cancer.

RT is now a core and essential element of an effective cancer treatment plan Worldwide, regardless of economic conditions. Radiation therapy is used to treat cancer is localized and provides local control (complete response, no recurrence in the treated area) or to relieve symptoms of locally advanced or disseminated cancer,.) It is also often used in conjunction with surgery Preoperative or postoperative or in combination with systemic chemotherapy before, during or after RT.

Since radiation effects on both cancer cells and surrounding normal tissues, achieving acceptable treatment rates defined as the probability of tumor control versus probability of unacceptable toxicity— needs the radiation dose (in units of Gy) to be delivered within very tightly controlled tolerances with less than %5 deviation. This complex and controlled radiation generation and precise application requires specialized equipment maintained and operated by a team of highly trained personnel. The team includes, at least, radiation oncologists to prescribe the appropriate dose, medical physicists to ensure accurate dose delivery, and radiation technologists to operate the equipment and guide patients through the radiation process.

Radiation therapy is applied in two ways as shown in figure (2):

- **External beam radiotherapy:** in which the beam of radiation is directed externally toward the tumors within the body.
- **Internal beam radiotherapy:** in which radiation-emitting sources are inserted directly within the tumor or adjacent body cavity. (2)

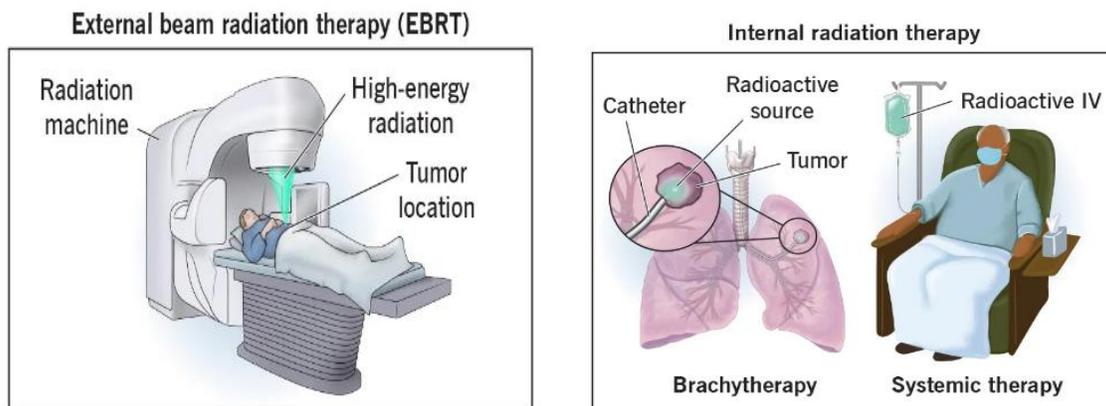


Figure (2): Comparing external beam radiotherapy and internal beam radiotherapy

Breast Cancer

Is cancer that develops in the breast tissue - usually in the ducts (the ducts that carry milk to the breast nipples) or lobules (glands that produce milk). It occurs in both men and women, but rarely in male.(5)

Breast cancer is the second most common cancer in women after skin cancer, according to European and American studies, in every eight women one is at risk of infecting by breast cancer. This is because it starts within the milk ducts, 70% of cases are this type of breast cancer.(1)

this name because it starts within the milk ducts, 70% of cases are this type of breast cancer.(1)

Symptoms of breast cancer

- Lump in chest
- Changes in breast size or shape
- Dimpled skin or thickened breast tissue
- Inverted nipples
- Rash on the nipple
- Nipple discharge
- Armpit swelling or lump
- Persistent chest pain or discomfort
- Reddened skin or skin thickening

Breast cancer is the leading cause of cancer-related death in women. In developed countries, one in eight women will get breast cancer in their lifetime. In Europe, a breast cancer diagnosis is made every 2 minutes, 1 person dies of breast cancer every 6 minutes. Breast cancer primarily affects older women, most of Patients older than 50 years when diagnosed, although about one in five breast cancer cases were previously diagnosed Start at age 50. Male breast cancer is rare, accounting for about 1% of breast cancer cases.(5)

How is breast cancer diagnosed?

Breast cancer can be diagnosed by clinical examination, imaging and biopsy.

• **Clinical examination**

Your doctor will examine your breasts and lymph node. He/she will also ask you about family Breast cancer history and whether you have menopause or not. He/she can also draw blood a sample for routine blood testing, if there is any doubt you may have a breast tumor, he/she can Schedule an imaging scan for you.

- **Imaging**

A-Mammogram

Is a low-dose x-ray that looks for early breast cancers, by placing breasts separately on X-ray machine and pressed between two plates to produce clear images. If a mammogram Screening reveals anything suspicious in breast tissue, the doctor investigates further.



Figure (5): Mammogram

B-Ultrasound

Uses high-frequency sound waves to create images of inside your body, for breast examinations, a hand-held ultrasound machine enables the doctor examines your breasts and lymph nodes in your armpits. Ultrasound can show either the lumps are firm or fluid-filled cysts.



Figure (6): Breast ultrasound

C-MRI

Uses magnetic fields and radio waves to create detailed images of the interior from your body. MRI scan may be used in some cases, such as patients with a family history of breast cancer, MRI is also used to see if the tumor is responding to treatment and to help plan future treatment.



Figure (7): Breast MRI

- **Biopsy**

Is removing a sample of breast cells for testing, biopsy your doctor uses a specialized needle device to extract a core of tissue from the targeted area of the breast, usually under ultrasound guidance (or sometimes with Mammography or MRI (if the tumor is not visible on ultrasound) to ensure the biopsy is taken from the correct area of the breast. A biopsy can give doctors important information about the breast cancer type and helps to plan treatment. A marker can be placed in the tumor at the same time as the biopsy to help surgeons remove the entire tumor later.(5)

Breast cancer Staging

Staging of cancer is used to describe its size and location, and whether it has spread from where it started as shown in chart (1) below. Clinical staging includes a physical examination, blood tests, and imaging tests, except your original Mammograms, which may require more scans, including computed tomography (CT) of your breasts Ultrasound, CT, or MRI scans of the chest and abdomen, and bone exam. Alternatively, Positron Emission Tomography (PET) scans can be used to evaluate the whole body. It is important for your doctor to know the stage of the cancer so that he/she can determine the best treatment approach.(5)

Stage 1	The tumor is small and confined to the breast tissue or shows signs of cancer in the lymph nodes near the breast.
Stage 2	The tumor is in the breast or nearby lymph nodes, or both.
Stage 3	The tumor has spread from the breast to the lymph nodes near the breast, to the skin of the breast, or to the chest wall.
Stage 4	The tumor has spread to other areas of the body.

Chart (1): Breast cancer staging

Types of breast cancer

1-Non-invasive breast cancer

- Ductal carcinoma in situ (DCIS) is a precancerous lesion - it's not cancer yet, but it can develop into invasive breast cancer, in this type of cancer, the cancer cells are located in the milk ducts of the breast, but without Spread into healthy breast tissue.
- Lobular neoplasia (formerly known as lobular carcinoma in situ) is a change in the cells lining the lobules indicating increased risk of future breast cancer, lobular neoplasia is not actually breast cancer, although women with lobular tumors are regularly screened, Most people will not get breast cancer.

2-Invasive breast cancer

Is cancer that has spread outside the milk ducts (invasive ductal), or lobules (invasive lobular breast cancer). These can be further classified according to their histology; for example, tubular, mucinous, myeloid, and papillary breast neoplasms are rarer subtypes of breast cancer. (5)

Breast cancer is also categorized according to the affected part, such as:

- The lobules are the glands that produce breast milk, Cancer that affects here is called *lobular cancer*.

- Ducts are small canals that come out of the lobules and deliver milk to nipple. This is the most common starting site for breast cancer, Cancer that affects here is called **ductal cancer**.
- Nipple which is an opening in the skin of the breast where the ducts come together to become larger ducts that allow the milk to leave the breast, cancer that affects the nipple is the less common type which is called **Paget disease of the breast**.
- Stroma which is the connective tissue that surrounds the ducts and lobules, the cancer that affects here is called **phylloides tumor**.
- **Angiosarcoma** is a type of breast cancer that affects the lining of blood and lymph vessels.(6)

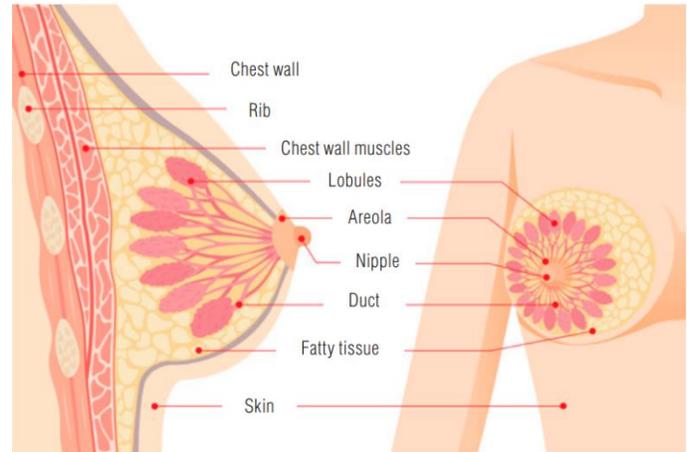
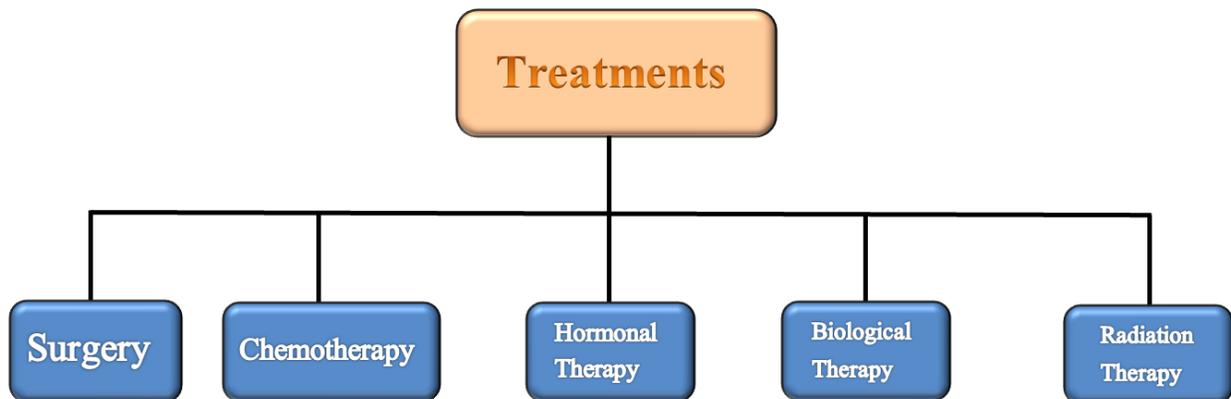


Figure (9): Parts of breast tissue

How breast cancer is treated?

Some treatments, such as surgery and radiation, are local, which means they treat the tumor without affecting other parts of the body. Most women with breast cancer will have some form of tumor surgery. Depending on the type and how advanced the breast cancer is, you may need other Type of treatment, pre-surgery or post-surgery, or sometimes both.(7)



Surgery

Most women with breast cancer will have some type of surgery as part of their treatment. There are different types of breast surgery that can be done for different reasons, it depends on the situation.(7)

The aim of breast cancer surgery is to:

- Remove as much of the cancer as possible (breast-conserving surgery or mastectomy).
- Find out if cancer has spread to the lymph nodes under the arm (sentinel Lymph node biopsy or axillary lymphadenectomy).
- Restoring breast shape after cancer removal (breast reconstruction).
- Relieve symptoms of advanced cancer.(7)

Although surgery is unlikely to cure breast cancer that has spread to other sites. It still helps the body in some cases, either to slow the spread cancer or prevention or relief of symptoms

Breast reconstruction

If you are having a mastectomy, you may want to consider having a Breast reconstruction. Breast reconstruction means reconstruction Breast shape after breast surgery, figure (12).

This is done by:

- Silicone or saline implants
- Or
- Tissue from another part of the body, such as fat Stomach.(8)



Figure (12): breast reconstruction

Hormonal Therapy

Sometimes called endocrine therapy is a medicine (drug) for women with breast cancer, whose cancer cells use hormone estrogen for growth. Hormone therapy makes cancer cells do not grow. They lower estrogen levels in the body, or prevent estrogen from entering cancer cell. The type of hormone therapy recommended for you depends on whether you missed your period (menopause) or not.

There are two types of hormonal therapy:

AROMATASE INHIBITORS

It reduces the amount of estrogen in the body. The most common are Arimidex, Femara and Aromasin. Aromatase inhibitors are only suitable for women whose menstruation stops forever (permanent menopause).

TAMOXIFEN

Prevents estrogen from entering the skin breast cancer cells. This prevents breast cancer cells from grow, tamoxifen can be used to treat women of all ages. Whether they miss their period (menopause) or not.

Targeted Therapy

Is medicine (drugs) used to treat certain diseases types of breast cancer. Most Common Targeted Therapy It's the drug Herceptin, it is used to treat breast cancer HER2 positive. This means that cancer cells are higher than Normal levels of HER2 protein. Herceptin works Stops cancer cells from growing and dividing.

HER2-positive breast cancer is a breast cancer that tests positive for a protein called human epidermal growth factor receptor 2 (HER2). This protein promotes the growth of cancer cells.

(8)

Radiotherapy

Is another type of treatment that is used to cure and treat breast and other types of cancer, radiotherapy is the abbreviation of radiation therapy that uses high energy radiations to kill cancer cells which makes them unable to repair or divide themselves by damaging genetic materials within the cells.

RT not only affects cancer cells but it also affects healthy cells but they have the ability to repair themselves.

Depending on the stage of cancer and other factors the radiotherapy can be used in many situations:

- After Breast Conserving Surgery (BCS), reduces cancer risk to come back in the same breast or in nearby lymph nodes
- After a mastectomy, especially if the cancer is larger than 5 centimeters (about 2 inches), When cancer is found in many lymph nodes, or when certain surgical margins such as Skin or muscle with cancer cells.
- If the cancer has spread to other parts of the body, such as bones, spinal cord, or brain.(7)



Figure (13): radiation effect on DNA

The process of external beam radiotherapy

Is the most common type of radiation therapy used to treat cancer. The machine directs beams of radiation through the skin at a specific part of the body, usually a tumor. You cannot see or feel external radiation therapy. It doesn't hurt, and it's not radioactive when you receive it. The length of treatment may vary depending on the type of equipment used. Typically, a session lasts about 30 minutes or more because it takes some time to set up the machine and get you in the correct position on the table. Giving the radiation dose usually only takes a few minutes, but it may take longer depending on the type of equipment used.(11)

There are 3 types of beams used in radiotherapy

- Photon beam
- Proton beam
- Electron beam

Photon beam

Most radiation therapy machines use photon beams. Photons are also used in X-rays, but X-rays use lower doses. Photon beams can reach tumors deep in the body. On the way through the body,

the photon rays scatter small amounts of radiation along the way. These rays do not stop when they reach the tumor, but instead penetrate it into normal tissue.

Proton beam

Protons are positively charged particles. Like photon beams, proton beams can reach tumors deep in the body. However, the proton beam does not scatter radiation as it travels through the body and stops once it reaches the tumor. Doctors believe that proton beams can reduce the amount of normal tissue that is exposed to radiation. Clinical trials are underway to compare proton beam versus photon beam radiation therapy. Some cancer centers use proton beams in radiation therapy, but the high cost and size of the machines limit their use.

Electron beam

Electrons are negatively charged particles. Their use is limited to tumors on the skin or near the surface of the body because electron beams cannot travel very deep through body tissue. (12)

External radiation therapy machines

The linear accelerator (**LINAC**) is the most commonly used external beam radiation therapy device. It sends high-energy X-rays to specific parts of the body. It can be used to treat any part of the body. Treatment is usually given in several sessions. Each session can last 15 to 30 minutes, sometimes even longer.(11)

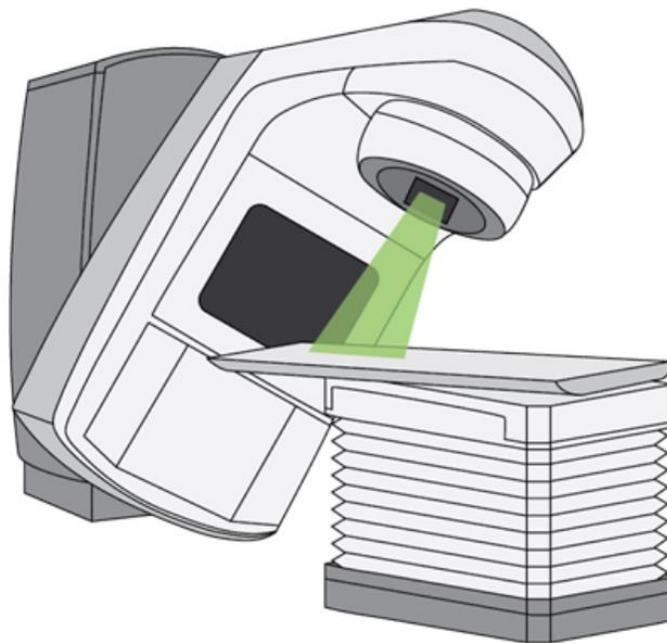


Figure (15): linear accelerator machine

The **CyberKnife** is a small, compact linear accelerator mounted on a robotic arm that moves around a subject, emitting radiation from a number of different directions. It also has several x-ray cameras (imaging devices). A computer tracks a person's location and movement. If a person moves slightly, the robotic system can adjust by repositioning the linac before the beam is released. Each session can last from 30 to 90 minutes. Not every cancer treatment center has a Cyberknife.(11)

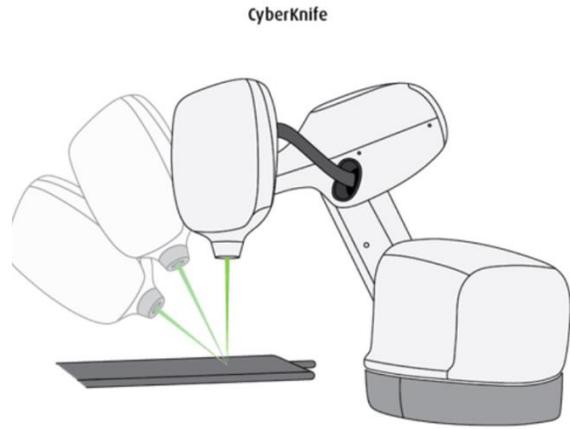


Figure (15): cyberknife machine

Statistic

In Zhianawa Cancer Center-Slemani we took the data of the patients that have visited in a year and we saw that 1460 patients have visited that year and 527 (%36.1) persons have diagnosed to have breast cancer which is the first most disease diagnosed in this center, as shown in chart (5).

Rank	Cancer	No. of patients	Frequency
1	Breast	527	36.10%
2	Lung	305	20.90%
3	Colorectal	211	14.45%
4	Prostate	208	14.34%
5	Stomach	111	7.60%
6	Other	98	6.71%

Chart (5): Relationship between number of patients and their cancer type

Also we noticed that the minimum cases diagnosed are those that the patients are 0-15 years old which is about %2-3 of breast cancer cases, the breast cancer mostly develops in the persons with 30 – 60 years old and the maximum breast cancer cases diagnosed in this center are the persons with age of 46-65 years old which is %45 of breast cancer cases, as shown in chart (6).

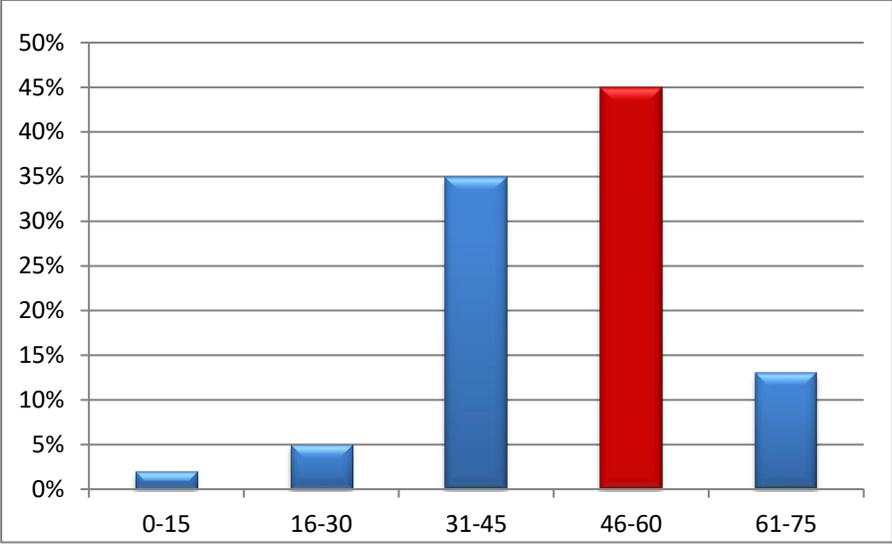


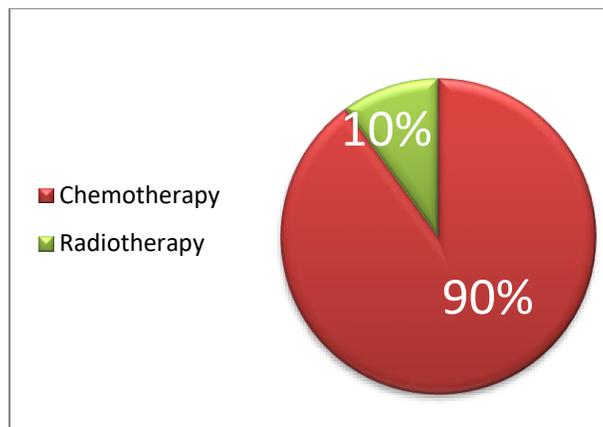
Chart (6): Relationship between number of patients and their age when they are diagnosed to have breast cancer

No. of patient	Frequency	Dose Rate (cGy)	Duration (day)
455	86.50%	4005	15
60	11.50%	2600	5
7	1.33%	2700	5
5	0.96%	3471	13

Chart(7) : A relation between number of patients, the amount of dose used in their radiotherapy, and duration.

Result

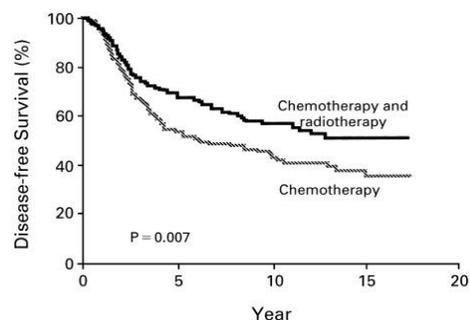
People diagnosed with breast cancer have a variety of treatment options available, depending on the type of cancer, its stage, and the person's general health at the time of diagnosis. Depending on the patient's medical history, cancer type, and stage, neither is “better or worse” rather, which is more appropriate and preferable to the patient. Ideally, anyone diagnosed with breast cancer should meet with a multidisciplinary team of specialists, including surgical, medical, and radiation oncologists, who can brief them on the latest and most effective treatment options they can consider. Treatment may involve one, two, or all three modalities, in varying order. Rarely, more than one method can successfully eradicate a particular cancer. Patients are shown the pros and cons of each approach to determine which is best for their wishes and goals.(9)



Graph (1): percentage of patients received chemotherapy or not

Radiotherapy is used to treat %10 of the breast cancer patients alone without chemotherapy, and other %90 of patients are received chemotherapy as long as radiotherapy after they are diagnosed to have breast cancer in zhiyanawa cancer center-sleman.

Treatment often requires a multifaceted approach. Attacking cancer in multiple ways, including radiation, chemotherapy, and surgery, may provide a better chance of cure or outcome. Combination therapy may increase or decrease the risk of side effects, depending on the type of tumor, its location, and the treatment regimen used. Common side effects of combination therapy also include fatigue, digestive problems, skin reactions, hair loss, pain, and fatigue. The decision to use chemotherapy, radiation, or both is complex and must be made with the advice of your oncology team. (9)



Graph (2): Relation between chance of survival and number of years after diagnoses, by using chemotherapy alone and combined with radiotherapy

Discussion

When we talk about each kind of cancer the humans think about chemotherapy for the cancer treatment, Soon after Roentgen discovered X-rays in 1895, ionizing radiation was used to the effect of treating cancer and the result was remarkable. Carefully Controlled Dosage of ionizing radiation damages DNA in cells, provides preferential acts on cancer cells compared to normal tissues, thereby saving lives and providing benefits in curing most types of cancer.(2)

RT is now a core and essential element of an effective cancer treatment plan Worldwide, regardless of economic conditions. Radiation therapy is used to treat cancer is localized and provides local control (complete response, no recurrence in the treated area) or to relieve symptoms of locally advanced or disseminated cancer,). It is also often used in conjunction with surgery Preoperative or postoperative or in combination with systemic chemotherapy before, during or after RT.(2)

Chemotherapy targets cancer cells throughout the body, usually through the use of cytotoxic drugs given intravenously. Radiation therapy uses high-energy rays, such as X-rays or protons, to target and kill cancer cells at a specific tumor site. Chemotherapy and radiation therapy both damage normal cells in their attempts to kill cancer cells. The nature of the side effects varies greatly depending on the mode of use.(13)

The main difference between chemotherapy and radiation therapy is how they are administered. Chemotherapy is a type of cancer treatment drug designed to kill cancer cells. It is usually given by mouth or through an IV or medicine line into a vein. There are many different types of chemotherapy drugs. Your doctor can prescribe the type that is most effective in treating your particular type of cancer. Chemotherapy can have many side effects, depending on the type of chemotherapy you receive. Radiation therapy involves administering high doses of radiation directly to the tumor. Radiation can alter a tumor's DNA, causing it to shrink or die. This type of cancer treatment has fewer side effects than chemotherapy because it targets only one area of the body.(13)

After our research in Zhianawa Cancer Center we found that like most of previous researches breast cancer is the first most common diagnosed cancer in women in this center, and the breast cancer develops mostly in the women whose age are between 45-60 years old(14), but unlike other developed countries they don't take benefit as much as possible by searching to many of developed countries researches, according to most researches we found that radiotherapy is used for treatment of more than %60 of breast cancer patients (15), also we found in our research that % 100 of breast cancer patients that visit this center are received radiotherapy to cure their disease.

Adjuvant therapy doses for breast cancer typically range from 45 to 60 Gy (4500-6000 cGy). Usually these doses are divided into several smaller doses given over a period of one to two

months. The specific dose for each patient depends on the location and severity of the tumor. Therefore, dosing decisions are at the discretion of the radiation oncologist responsible for such treatment decisions (16), also according to our research the maximum dose used is 4005 cGy that used for %86.5 of breast cancer patients that last for 15 days, and minimum dose used is 2600 cGy that is used for %11.5 of breast cancer patients.

References

1. <https://www.moh.gov.sa/en/awarenessplatform/ChronicDisease/Documents/Breast%20Cancer.pdf>
2. Jaffray, D. and Gospodarowicz, M. (n.d.). *Chapter 14. Radiation Therapy for Cancer*.
3. Locoregional Therapy: Radiation Therapy for Breast Cancer. (n.d.).
4. <https://nuclearsafety.gc.ca/eng/pdfs/Reading-Room/radiation/Introduction-to-Radiation-eng.pdf>
5. ESMO Patient Guide Series based on the ESMO Clinical Practice Guidelines. (n.d.).
6. American Cancer Society (2021). *Types of Breast Cancer | Different Breast Cancer Types*.
7. O'Shaughnessy, J.A. (2000). Treating Breast Precancer. *Clinical Breast Cancer*, 1, pp.S74–S79.
8. Breast cancer treatments. (n.d.). Available at: https://www.bcna.org.au/media/2151/bcn849-easy-english-resource-breast-cancer-treatments_final_030215lr.pdf.
9. https://breastcancernow.org/sites/default/files/publications/pdf/bcc17_chemotherapy_2021_web.pdf
10. Shapiro, A. and Lai, L. (n.d.). Available at: <https://www.upstate.edu/hospital/pdf/healthlink/IORT-oasis.pdf> [Accessed 23 Mar. 2023].
11. Lee, S. (2015). *External radiation therapy*
12. National Cancer Institute (2018). *External Beam Radiation*
13. Healthline. (2020). *Radiation vs. Chemo: Uses, Benefits, Side Effects, More*.
14. Centers for Disease Control and Prevention (2021). *What are the risk factors for breast cancer?*
15. Maliko, N., Stam, M.R., Boersma, L.J., Vrancken Peeters, M.-J.T.F.D., Wouters, M.W.J.M., KleinJan, E., Mulder, M., Essers, M., Hurkmans, C.W. and Bijker, N. (2022). Transparency in quality of radiotherapy for breast cancer in the Netherlands: a national registration of radiotherapy-parameters. *Radiation Oncology*, 17(1).
16. News-Medical.net. (2010). *Radiation Therapy Dosage*
17. <https://www.nejm.org/doi/full/10.1056/nejm199710023371402>

