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A Short Review on the Imaging Technology in Radiation Therapy

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ABSTRACT

Advanced radiotherapy treatments, such as intensity modulated radiation therapy (IMRT), helical tomotherapy, stereotactic body radiation therapy (SBRT), robotic radiotherapy, and proton beam radiation therapy, have been developed as a result of recent developments in imaging. Higher doses of radiation could be delivered to the tumor while normal surrounding tissues are spared if imaging is used properly. In this paper, we examine the specific advancements for each technology and assess their usefulness based on the researcher's study's performance and data. X-rays produce images of internal tissues, bones, and organs on film or digital media by using invisible electromagnetic energy beams. Standard X-rays are used for a variety of purposes, including the diagnosis of cancers and bone injuries. X-rays are commonly used in cancer treatment and clinical diagnosis devices for medical radiography. Other diagnostic methods that involve X-ray technology include mammography, computed tomography (CT) scans and fluoroscopy. Radiation from diagnostic imaging modalities are minor contributors to the cumulative dose exposures of healthcare staff. On the other hand, any radiation exposure poses a risk to both patients and medical staff. Radiation protection aims to lessen the unfortunate consequences of ionizing radiation by lessen redundant radiation exposure. These breakthroughs have the potential to improve clinical results and

lessen long-term radiation-related toxicity. Also, show how current advancements in imaging and radiotherapy delivery can be coupled to determine the future of precision radiation oncology. In addition, based on numerous features, several problems in the employment of sophisticated technology are mentioned.

Keywords: Imaging; Radiotherapy; X-rays; Technology; Radiation

INTRODUCTION

Radiation oncology is a medical specialty that is an essential part of a multidisciplinary approach to cancer treatment. Currently, radiotherapy is used in roughly 40% of cancercures, either as a solo treatment or in combination with other treatments like surgery or chemotherapy (Sharma et al., 2016). Oncology has seen a number of technical advancements in recent years, including more precise radiation therapy and minimally invasive surgical approaches. Furthermore, a growing body of evidencecurrently supports the use of high-dose irradiation in the treatment of oligometastatic disease; radiation is supplied to a small number of metastases, and studies have shown increased local control rates for several tumor locations (Lutz et al., 2014). A number of significant technological advancements in the last decade, such as image-guided radiotherapy (IGRT), intensity-modulated radiotherapy (IMRT), stereotactic body radiotherapy (SBRT), and proton beam therapy (PBT), have accelerated the concept of "precision radiotherapy." Greater conformity, smaller planning margins, and the administration of a higher dose tothe tumor are all benefits of modern radiation treatments, which could lead to better patient outcomes (Tree et al., 2013). Patients and doctors alike want access to this new technology, which are quickly becoming normal therapeutic practice. Marketing that depicts new technologies as the "latest and best" treatments available typically drives up demand. However, data to back up these claims is sometimes weak, and these novel technologies are frequently employed to treat individuals who could have had identical results with a less expensive, conventional treatment.

Rector Wilhelm Conrad Roentgen, a professor in Germany identified X-rays in 1895. He was investigating with positive and negative electrodes in a tube when he discovered that removing the air from the tube and applying a high voltage caused the tube to glow. He deduced that the tube was emitting a new form of radiation capable of passing through dense materials. According to Roentgen's discovery, X-rays, the same as light rays, are a configuration of electromagnetic radiation, but they have more energy and can penetrate through most objects. After his first finding, Roentgen did more experiments to better understand how this unique ray behaved. He discovered that x-rays could pierce human skin but not denser materials such as bone or metals, and it also can be photographed (Arne Hessenbruch, 2002). After many research and development, nowadays x-ray is a fast, hurtless diagnostic that generates images of the structures inside your body, specifically your bones. The term "x-ray" is about the fact that originally visible electromagnetic wavelengths were converted to shorter, invisible wavelengths as they passed through the body.

X-ray beams pass through your body and are captivated in various degrees depending on the density of the tissue they pass through. These pictures are then merged to create clearer images for doctors to review. X-rays, in fact, one of the most extensively used imaging techniques available for medical purposes, making it an indispensable part of many diagnosis procedures. It provides high quality, low- cost images with minimal ionizing radiation exposure to patients and operators alike and reabsorbed in diverse volumes dependent on the density of the substance through where they pass. Dense materials like bone and metal illustrate white on X-rays while your lungs seem to be filled with black air. Grayscale representations of fat and muscle appear. Scientists discovered unseeable high-energy radiation rays (X-, α-, β-, and γ-rays) in the 1890s due to their ability to ignite phosphors such as $K_2PT(CN)_4$ (Schueler, 1998). X-rays (0.01–10 nm)/-rays (0.01 nm) have a high penetrating power, allowing for non- destructive security review and medical imaging by revealing the internal structure of scanned condensed objects. After ionizing the subjects through interchange with atomic electrons, X-ray/-ray can transfer exact inner recovery data of the investigated substances by the alteration in radiant attributes (phase, direction, dosage rate/photon intensity, and wavelength). The radiation enters the bodies or subjects and is distinguished and examined. The variable signal detected in radiation absorption causes the imaging contrast, which restricts the ability of different organs or individuals to be exposed to radiation. Since the x-rays absorbed by these materials are barely detectable by standard photographic substrates, researchers are working on developing materials that can convert them into photon radiation.

LITERATURE REVIEW

Technology Advance In Radiation Therapy

Innovative technology is significant in promoting the quality of care and outcomes for radiation therapy patients. Advances in radiation oncology technology, as well as the capacity to precisely target tumors with highly focused radiation, have improved local control, radiation therapy planning and survival for certain cancers. Advances in imaging technology, including the development of computerized tomography (CT), magnetic resonance imaging (MRI), positron-emission tomography (PET), and fusion PET/CT, have substantially increased the capacity to attain this goal over the last two decades (Galvin et al., 2004). In classical radiation therapy, a small number of X-ray photons are administered into the tumour site. The beams are two-dimensional rather than three-dimensional. 3D conformal radiotherapy radiation beams are moulded and then combined to more accurately fit the profile of the targeted tumour thanks to sophisticated computer software and 3D imaging. Some of the methods that have been developed based on 3D conformal radiotherapy include intensity modulated radiation therapy (IMRT), helical tomotherapy, stereotactic body radiation therapy (SBRT), robotic radiotherapy, and proton beamradiation therapy (PBRT).

Intensity Modulated Radiation Treatment (IMRT)

Intensity modulated radiation therapy (IMRT) is a more advanced kind of three-dimensional conformal radiotherapy in which non-uniform intensities are assigned to a small subdivision of beams known as beamlets. To accurately irradiate a tumor, IMRT employs many tiny photon or proton beams of various strengths. Each beam's radiation intensity is adjusted, and the beam form changes with each treatment. As a result, custom-designed optimal dose distributions are achievable. Improved dose distributions frequently result in better tumor control and less toxicity in healthy tissue. The radiation dosage intensity is highest for the gross tumor volume, but radiation to nearby normal tissue can be reduced or avoided entirely with appropriate planning. The relative intensities of tens of thousands of individual beamlets that make up an intensity modulated treatment plan must be specified in IMRT. This operation is impossible to complete manually and necessitates the use of a multileaf collimator (MLC) as well as specialized computer assisted optimization approaches (Salminen et al., 2011).

IMRT reduces radiation exposure to the rectum in prostate cancer and the small bowel and bone marrow in gynaecological tumours, according to Steve Chmura, Associate Professor of Radiation and Cellular Oncology at the University of Chicago. IMRT can also be used to deliver radiation to a moving target, such as a lung tumour that moves with breathing, thanks to real-time imaging and modifications. Although IMRT employs many treatment fields from various angles, it may increase the volume of normal tissue receiving low doses, potentially increasing the risk of subsequent malignancies especially for children. Data should be collected in advance of the implementation of any modern technology, such as IMRT to allow a full cost-effectiveness and cost-benefit analysis.

Helical Tomotherapy

Helical tomotherapy is a type of radiation therapy that uses a slice-by-slice delivery system (hence the use of the Greek prefix tomo-, which means "slice"). Other forms of external beam radiation therapy, in which the entire tumor volume is treated at once (Mackie et al., 1993), do not use this technique of delivery. The whole treatment period is brief, which is the main benefit of this method.

The development of radiation therapy has placed a major emphasis on dose uniformity across the tumor.Helical tomotherapy entails the delivery of radiation to distinct regions of the tumor in a sequential manner, which creates two significant challenges. To begin with, this procedure, known as 'field matching,' carries the risk of a less-than-perfect match between two neighboring fields, resulting in a 'hot area' and/or 'cold spot' within the tumor. The second problem is that if the patient or tumor moves during successive administration, a hot or cold area may form.

The first issue can be solved, or at least reduced, by carefully designing the beam delivery mechanism. The second necessitates paying great attention to the target's position during the treatment process.

Stereotactic Body Radiation Therapy (SBRT)

The delivery of a relatively high dosage of radiation to a small volume using a precise stereotactic localization technique is known as stereotactic radiotherapy (commonly known as "radiosurgery" despite the fact that there is no surgery involved). The stereotactic component of the procedure refers to the patient being immobilized or fixed with a rigid head frame system that establishes a patient-specific coordinate system for the whole treatment process (Bourland, 2007). SBRT is being put to novel uses by radiation oncologists, and it is particularly useful in the ablation of metastases. Chmura showed out that metastatic breast cancer can manifest itself as a small number of tumors in a few organs (oligometastatic). Instead of eliminating these tumors surgically or treating them only with chemotherapy, stereotactic radiation treatment is increasingly being used to treat them (Lewis et al., 2017).

Stereotactic radiation is used to treat tiny intracranial tumors in general, pituitary adenomas, small meningiomas, acoustic neuroma, craniopharyngioma, pineal tumors, brain metastases, and non- malignant disorders such arteriovenous malformations. Localized liver tumors are also treated with stereotactic body irradiation. Stereotactic radiotherapy can be performed using a linear accelerator that has been adjusted. The linear accelerator is modified to take a tertiary collimator assembly for precisely positioning circular collimators to generate small circular fields with diameters ranging from 4 to 40 mm. Radiation routes that follow arcs distribute the peripheral dosage over a vast area. Stereotactic radiation is a prominent and increasingly used treatment that is constantly being developed.

Robotic Radiotherapy

A frameless robotic radiosurgery system is known as robotic radiotherapy. The radiation produced by a small linear accelerator and a robotic arm, which allows the energy to be directed towards any portion of the body from any direction, are the two major components of robotic radiotherapy. The robotic radiation system is a way of administering radiotherapy with the goal of more precisely targeting treatment than traditional radiotherapy. It is not widely available due to its expensive cost, despite the fact that the number of centers offering the therapy has increased to over 150 in recent years, mainly in North America, East Asia, and Europe. The robotic radiation system is utilized to treat both malignant and benign tumors, as well as a variety of other medical issues.

Proton Beam Radiation Therapy (PBRT)

To compensate for the loss of beam intensity as depth into the body grows, traditional radiation therapy uses higher doses of radiation. Proton beams, on the other hand, can be driven into the body to deposit only a little quantity of radiation until the protons slow down, at which point all of the radiation is deposited, leaving little residual radiation beyond the tumour. Because proton beam radiation treatment (PBRT) consumes less radiation and there is no radiation exit dose once the beam leaves the tumour, according to Zietman, this technique should allow for higher radiation doses and, in theory, better tumour response while reducing late radiation effects (Zietman et al., 2010). Many PBRT clinics are also experimenting with using the treatment on other tumours to see whether it improves results, he said, in order to expand their patient base and make the approach more financially sustainable. Because of its precision and lower radiation doses, PBRT is being used to treat cancers that may not respond to standard radiation therapy due to concerns about damaging nearby tissues. Pancreatic, peritoneal, paranasal sinus, lung, and liver cancers, as well as left-sided breast cancer, have all been treated with PBRT (which is closer to the heart).

Effectiveness Comparisons of Recent Technologies

The risk of brain radiation exposure from IMRT is extremely significant, especially in children. However, some studies recommend lowering the dose in IMRT to prevent hearing loss or growth hormone deficiency. In addition, studies show that when used to treat gynecologic cancers, breast cancers, and head and neck cancers in adults, IMRT causes less radiation damage to normal tissue than conventional two-dimensional (2D) or three-dimensional (3D) radiation therapy (Brixey et al., 2002).

Despite the fact that studies have shown that PBRT reduces the amount of radiation deposited in healthy tissues when compared to IMRT (Efstathiou et al., 2009), They believes that more study is needed to verify that this is therapeutically meaningful. Although there is inconsistent evidence on whether PBRT truly improves unfavourable outcomes when compared to other therapy, according to Coen et al., 2012, it was not more successful than conventional drugs in treating prostate cancer, as expected. Smith discussed a study that used Medicare claims data to examine the side effects of PBRT and IMRT for the treatment of prostate cancer. Within 6 months of radiation treatment, this study discovered a slight reduction in the number of genitourinary disorders, but no differences were seen at 12 months.

Surgical excision of the afflicted lung lobe is the conventional treatment for early-stage non- small-cell lung cancer. However, some older patients whose health is damaged by other illnesses are unable to undergo such surgery, leading to the hypothesis that these people might benefit from stereotactic radiation treatment. Despite the fact that stereotactic radiosurgery alone resulted in worse intracranial tumor control, investigators found no difference in survival in a prospective randomized clinical trial comparing two treatment regimens for patients with brain metastases (stereotactic radiosurgery alone or combined with whole-brain radiation), Smith reported. The authors of the study concluded that individuals treated alone with stereotactic radiosurgery had better cognitive and functional status, leading them to advocate radiosurgery alone for such patients (Alemozaffar et al., 2012).

When comparing the success of robotic surgical procedures, it's vital to consider the operator's skill and the sort of robotic instrument employed. According to studies, the minimum amount of experience required to reduce difficulties with robotic surgery is 150 cases, while the minimum amount of experience required to reduce the rate of positive tumor margins to less than 10% is 1,600 instances. After 750 cases, the operating duration plateaus, and sexual function preservation thresholds are reached at 1,400 cases. Wright discussed research into robotic hysterectomy surgery. According to the findings, robotic surgery is linked to better outcomes when compared to open abdominal surgery. However, when compared to laparoscopic hysterectomies, there is little to no benefit, and there is nodifference in complications or lymph node yields, which are used as a proxy for quality in gynecologiconcology (Wright et al., 2012).

Challenges for Adoption of New Technologies

Cost, efficacy, and ethics are all raised by the potential or current usage of increasingly technological technology. Higher capital and operating costs, as well as the economic burden of increased quality assurance, are a problem (Williamson et al., 2008). Stereotactic radiosurgery, stereotactic body radiation therapy (SBRT), proton and other charged particle therapies that use single or hypo-fractionation regimens have the advantage of saving time, but they require highly qualified personnel and excellent QA/QC programs because there is little room for adjustment once treatment has begun.

Time and movement: In areas of the body where organs and tumors may migrate during therapy, radiation oncologists have unique challenges. Movement of the target during treatment, whether owing to respiration or for any other reason, increases the danger of missing or underdosing thetargeted area. The movements of organs and tumors have a substantial impact on the accuracy of the dose delivery as the delivery of the radiation dosage gets more accurate. This is especiallytrue for tumors in the chest, because they move during breathing. Tumors in the larynx, abdomen(liver), prostate, and bladder21, as well as tumors in the pelvis in general, migrate during and between therapeutic applications.

Proton beam and heavy ions: When compared to photon beam (X-ray) radiotherapy, particle therapy, particularly proton therapy, has the advantage of providing a more precise dose distribution. The lack of evidence on clinical benefit from comparable controlled clinical trials is one of the key difficulties regarding the use of proton treatment. While physical studies on proton therapy have clearly demonstrated the superiority of proton therapy's dose distribution, clinical evidence comes primarily from phase II clinical studies or retrospective series. Another problem currently facing proton beam therapy is its cost-effectiveness. Proton therapy requires a complex facility with accelerators such as cyclotrons or synchrotrons to be implemented. To show that proton therapy should be included in mainstream cancer treatment modalities, a socioeconomic cost-benefit analysis is required.

The following are the major roadblocks to using technologically advanced equipment and techniques: sufficient human resources, qualified and trained staff for accurate delivery of high therapeutic radiationdoses; infrastructure requirements capable of handling this technology most efficiently and effectively; types and stages of cancers to be treated; development of commissioning and QA/QC protocols; and institutional resources and clinical backup to deal with increased dosimetry. Advanced technology needsfor radiation oncology must be addressed in the context of the needs of the countries concerned in termsof key infrastructure in order to allow for a smooth, progressive, and safe transition to increased radiotherapy treatments.

Types of Diagnosis Method in X-Ray

Currently, medical imaging is a critical element of medical practice. When diagnosing an illness or disease, doctors frequently request diagnostic scans for instance an x-ray, a computed tomography (CT) scan, or a magnetic resonance imaging (MRI) scan. While medical knowledge and discernment serve as the groundwork for healthcare experts analyzes and decisions, medical imaging is required to confirm any diagnosis. As technology advances, medical imaging can alert doctors to interior abnormalities thata routine external check would overlook. Medical imaging is crucial when tracking the development of an ongoing illness. Doctors can use MRIs and CT scans to analyze the effectiveness of treatment and adjust treatments as needed (Mubarak et al., 2021).

Many procedures and examinations require x-ray to analyze or treat patients, such as x-ray radiography, which may detect bone breakage, dental problems, and foreign objects in our bodies. This treatment can be received at any clinic or hospital as it one of the basic and easy procedure. Other than that, mammography. Mammography is a radiograph of the breast that is used to distinguish and diagnose cancer. Tumors typically present on radiographs as consistent or uneven-shaped lumps that are slightly brighter than the background. Mammograms can also identify microcalcifications, which appear as bright spots on a mammogram. While microcalcifications are usually harmless, they can indicate the presence of tumor in some cases. Furthermore, this method combines basic x-ray technology with computer processing to create a series of cross-sectional images of the body, which may subsequently be combined to form a three-dimensional x-ray image. Computed Tomography (CT) images are more comprehensive than usual radiography and allow doctors to examine structures within the body from a number of different perspectives. Finally, fluoroscopy is used to study the beating heart's movement as well as blood flow to and from the heart muscle, including through blood arteries and organs, using radiographic contrast chemicals. By using both x-rays and a fluorescent screen, we can receive real-time images of movement within the body or monitor diagnostic processes, for example, tracing the path of an injected or swallowed contrast agent.

Mammography

A mammogram is a kind of X-ray that is used to observe the breast. It is a screening technique for breast cancer. Mammograms, together with frequent clinical exams and monthly breast self- examinations, play a significant part in the early finding of breast cancer. Even if the thought of having one makes you uneasy, annual mammograms are necessary beyond the age of 40. A mammogram can be used for either screening or diagnosis (Pisano et al., 2005). Mammogram for screening. A screening mammography is used to spot potentially cancerous breast abnormalities in persons who have no signs or symptoms. The objective is to discover cancer while it is still small so that the therapy can be less invasive.

Mammogram for diagnosis. A diagnostic mammography is used to inspect abnormal breast changes such a new breast lump, breast soreness, odd skin appearance, nipple thickening, or nipple discharge. It's also used to assess unusual discoveries on an evaluating mammography. Additional mammography pictures are included in a diagnostic mammogram. Throughout the process, a compressor will then be used to flatten the tissue in the breast. This gives a more accurate representation of the breast. Each image may require Mammogram images can assist in the detection of calcifications, or calcium deposits, in your breasts. The test can also detect cysts, which may appear and disappear naturally throughout some people's menstrual cycles, as well as any malignant or noncancerous masses. you to hold your breath. You may feel some pressure or discomfort, but it is normally just temporary. The processes of picture acquisition, image display, and image storage are separated in digital mammography, allowing each to be optimized (Pisano et al., 2005).

Computed Tomography (CT) Scans

The energy of the X-rays in Computed Tomography (CT), which is utilised for diagnostic imaging is around 120 keV. Photo-electric absorption or Compton scatter attenuates each X-ray that passes through an object. If the intensity of an X-ray beam of a specific energy or wavelength is computed in terms of the number of photons, N, exiting the source. Absorption and scattering will reduce the number of photons detected at the detectors, Nd. (Shepp et al., 1978). A narrow beam of x-rays is fixated on a patient and quickly rotated around the body, creating signals that are evaluated by the machine's computer to form cross- sectional images or "slices" of the body. Since they transmit additional data than normal x-rays, these slices are referred as tomographic images. After the computer on the machine has collected multiple arrangements slices, they can be digitally "stacked" simultaneously to create a three-dimensional imageof the patient, making it easier to detect and identify elementary components as well as suspected tumors or oddities. In a Computed Tomography (CT) scanner, a motor-powered x-ray source spins around the circular entrance of a donut-shaped frame known as a gantry. The patient lies on a bed that moves deliberately across the gantry as an x-ray tube spins around the patient, emitting narrow beams of x-rays through the body. Instead of film, CT scanners use digital x-ray detectors that are positioned approximately opposite the x-ray source. The detectors take up the x-rays as they leave the patient and transfer the data to a computer.

Dense substances, such as bones, are easily seen on a CT scan. Soft tissues, on the other hand, do notshow up as well. They may appear blurry in the image. To make them stand out, you may need to use aspecific dye known as a contrast substance. They absorb X-rays and look white on scans, highlighting blood arteries, organs, and other structures. Iodine or barium sulphate are the most common contrast materials. Patient may get these medications in one of three ways. Firstly, injection. The medications are injected into a vein directly. This is done to enhance the visibility of your blood vessels, urinary tract, liver, or gallbladder in the image. Then, by orally (Crawford and King, 1990). The patient will consume a drink containingcontrast material that can improve scans of your digestive tract, which is the path of food through your body. Other than that, using the enema method when the patient's intestines are being scanned, the contrast material can be inserted in your rectum. The patient needs to stay hydrated after the CT scan to help your kidneys flush the contrast substance from your body.

Fluoroscopy

Fluoroscopy is a medical imaging test that creates a picture by moving an x-ray beam continuously over the body. The image is presented on a screen, allowing doctors to view the movement of inside organs in real time. The physique part being analyzed is continuously irradiated to X-ray radiation. The beam is then sent to TV-style monitor, which shows the body part and its motion in remarkable feature. Fluoroscopy is a type of imaging technique that permits doctors to observe at a variation of physical systems, including the skeletal, digestive, urinary, respiratory, and reproductive systems. Fluoroscopy can be utilized to focus on specific body parts including bones, muscles, and joints, as well as solid organs like the heart, lungs, and kidneys. Barium X-rays, cardiac catheterization, arthrography (visualisation of a joint or joints), lumbar puncture, placement of intravenous (IV) catheters (hollow tubes inserted into veins or arteries), intravenous pyelogram, hysterosalpingogram, and biopsies are all examples of examinations and procedures that use fluoroscopy (Katada et al., 1996).

Angiography

Angiography is the radiologic imaging of blood arteries after a contrast material has been injected. Contrast material is injected through a catheter into the vessel of interest to visualize this low-contrast structure. The usage of positive contrast media is more widespread. These operations require the use of highly specialized imaging equipment. Angiography can be more specifically described in 4 terms. First Arteriography where it is imaging the arteries, Venography imaging of the veins, Angiocardiography, imaging of the heart and associated structure, and lastly Lymphography, imaging of the lymphatic vessels or nodes. This procedure uses a radiopaque contrast material to monitor the blood flow in the artery. To perform angiography, a digital fluoroscopic image is paired with the injection of contrast material and the real-time subtraction of the pre- and post-contrast image (Bonnie, 2007). The risks of Digital Subtraction Angiography (DSA) include various complications, such as bleeding or dissection. They can also cause allergic reactions and/or cardiopulmonary toxicity. A magnetic resonance angiography is a non-invasive technique that uses radio waves to examine the vascular system. It eliminates the risks of invasive arteriography and is typically performed for patients with unstable or delayed arteriography (Blumgart, 2007).

Angiography is a procedure that takes images of the blood flow through your arteries. The doctor uses X-ray and contrast media to monitor the movement of blood in each artery. This procedure can be done on many different parts of your body. An arteriogram is often used to diagnose or determine the cause of confusing symptoms, including pain or bleeding. The procedure can be done quickly in an outpatient center, and only causes minor discomfort (Harding, 1987). Doctor may recommend that you have an arteriogram if you have experienced the following symptoms. A burning sensation can be felt after the dye is injected. After the procedure, the pressure will be applied to the site where the catheter is placed to prevent bleeding. It can be done in a hospital X-ray or radiology section and generally takes between 30 minutes and 2 hours. This procedure is typically performed while you are sedated.

Safety Procedures

Radiation protection and safety protocols have been designed to guarantee the protection and safety of employees, patients, and their relatives throughout their presence in the department, as well as to ensure the fertile and prenatal women are not accidently or intentionally disclose to radiation (Tsapaki et al., 2018). By applying the correct techniques, equipment, and shielding materials, radiation safety regulations ensure that both patients and radiation health workers are not exposed to needless radiation. Radiation protection aims to reduce ionizing radiation's negative effects by limiting excessive exposure (Rehani et al., 2010). Ionizing radiation has become an inevitable instrument in the medical field for the analysis and treatment of a broad range of medical issues. There are several requirements that relate to the patient's protection, such as employing a high kilovoltage (kV) approach for chest x-ray procedures, using decent quality film, and giving the patient a low radiation dose. Aside from that, everyone in the vicinity will be well protected from radiation. In the x-ray area, there are lead barriers, a gonadal shield, and a lead gown. Furthermore, radiographers should confirm that patients, families, and employees are correctly trained before completing an x-ray exposure. Pregnant women should also be x-rayed with caution and the radiologist should be informed of the treatment plan to justify the test. As example, when we need to receive x-ray treatment, the medical staff need to take care all our belongings such as necklace, bracelet, and ring as it can block or disturb the x-ray image. At the same time, radiation staffs can manage and restrict their contact to radiated radiation by using time, distance, and shielding. First, when the amount of time spent exposed to a radiation source is reduced, likewise the worker's exposure. Second, if possible, increase the gap between you and the source of radiation, such as an impenetrable source or an x-ray tube. The inverse of the squared length reduces the amount of radiation exposure. Suitable radiation shielding, such as automatic interlock systems and in-place radiation monitoring sensors, is used in the third level of exposure management. Apart from temporary or movable shields, protective curtains, and lead or lead equivalent aprons, this type of control is normally incorporated into the specific facility, for instance concrete barriers next to a radiation oncology accelerator (Thariat et al., 2013).

CONCLUSION

Recent technological advancements in radiation oncology have resulted in improved dose distributions and lower toxicity in selected tumor areas, which could lead to enhanced local tumor control and cure rates. This is one of the reasons why radiation doctors and hospital executives have become more interested in these therapies. Increased income from IMRT and other innovative technologies, on the other hand, may lead to their overuse. At this moment, the clinical scientific data for local tumor control and overall cancer survival for most tumor sites is equivocal. More clinical trials are required to establish the benefits of modern technology before they are widely utilized. We will need to expand our efforts in applying cost benefit and comparative effectiveness methodologies to record the improvements that innovative technology may give in patient care as a result of growing global concern about the ever- increasing expense of health care and of sophisticated new technology. Besides that, radiotherapy has been determined by continuous high-tech revolutions since the discovery of X-rays in 1895. Radiotherapy's purpose is to mould the best isodose on the tumor volume while protecting healthy tissues. When it comes to radiotherapy, there are three benefits which are patient cure, organ preservation, and cost-effectiveness. The effectiveness and acceptability of radiotherapy have been proven in randomised trials in several cancers, including breast, prostate, and rectum, with a high level of study proof. Proton and particle beam radiation, which is frequently applied in conjunction with surgery and medical treatment in a multidisciplinary and personalized cancer strategy has recently strengthened these developments.

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