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The Evolution of Radiation Therapy in Treating Cancer

Dorothy Abshire and Matthew K. Lang

Objectives: *Describe the significant changes that have occurred to elevate radiation therapy as a significant modality in treating cancer.*

Data Sources: *Peer-reviewed and lay publications.*

Conclusion: *Radiation has been used in medicine since its discovery in the 19th century. Since the start of the 20th century, radiation has been increasingly used to diagnose and treat cancer. Although, radiation therapy was often known to destroy healthy tissue in its attempt to kill cancer cells, technological advancements have allowed for precise and accurate therapy, providing a viable option as a cure for individuals diagnosed with cancer.*

Implications for Nursing Practice: *As radiation therapy is increasingly utilized as a treatment option for patients with cancer, it is critical for oncology nurses to be cognizant of this treatment modality and to understand how it impacts our patients.*

Key Words: *radiation oncology, innovation, technology.*

Cancer is the number one global cause of death. In 2012, the International Agency for Research on Cancer (IARC) reported 14.1 million new cancer cases and 8.2 million deaths caused by cancer.[1] Thus, finding safe and effective methods of treatment is critical. Since Marie Curie's discovery of radium in 1898 and the utilization of radioactivity and x-rays in medical applications, radiation has been useful by directly killing cancer cells or by causing DNA damage leading to tumor cell death.[2] Thus, therapeutic radiation, along with chemotherapy, immunotherapy, hormonal therapy, and surgery, has become one of the primary treatment modalities to treat cancer. Since the late 1900s, innovations in delivery and improvements in existing technology have enhanced the accuracy of radiation treatments, improved the quality of treatment delivery, and increased the survival rate for many patients with cancer.[3] In the United States, an estimated 60% of cancer patients receive radiation treatment at some point during the course of treatments.[4] Radiotherapy is also used in the palliative care setting. For example, radiation therapy is often used to relieve pain for patients with bone metastasis; to decrease the size of tumors that block airways or the esophagus; or to improve the patient's

Dorothy Abshire, BSN, RN, OCN®: *Oncology Nurse Clinician, Baylor Scott & White Medical Center – Hillcrest, Waco, TX*. Matthew K. Lang, BSRT: *Manager, Radiation Oncology, Baylor Scott & White Medical Center – Hillcrest, Waco, TX*.

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Address correspondence to Dorothy Abshire, BSN, RN, OCN®, Baylor Scott & White Medical Center – Hillcrest, 100 Hillcrest Medical Boulevard, Waco, TX 76712. e-mail: Dorothy.Abshire@bswhealth.org

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ability to breathe or swallow food. Jaffray and Gospodarwicz[5] note that radiation therapy has the potential to improve the rates of cure of 3.5 million people globally and provide palliative relief for an additional 3.5 million more.

Radiation experts have a two-fold goal: to safely increase the amount of radiation dose a tumor receives, and to protect healthy tissues from the dose to reduce toxicity to the site. Incorporating cutting-edge technology into the field of radiation oncology has assisted in dramatic improvements in reaching these goals. Radiation alone, or in combination with other treatment modalities, results in significant improvements in tumor cure rates. To illustrate this point, scientists conducted a study with gastric cancer patients.[6] They discovered radiation combined with chemotherapy resulted in a better survival rate than treating with chemotherapy alone. Chemoradiation resulted in an average survival of 46.7 months post treatment compared with 20.9 months for those who received chemotherapy alone after surgery. Further indicating the impact of radiation, 46.9% of chemoradiation-plus-surgery patients were still alive five years after treatment while only 24.9% of chemotherapy-plus-surgery patients survived five years after treatment. Moreover, the study showed that survival rates for those who received radiation in addition to other treatment modalities increased even for those with gastric cancers that had spread to lymph nodes.[6]

Technological Advancements That Have Improved Radiotherapy

There are two types of radiation treatments that are currently used: external beam radiation and internal radiation, called *brachytherapy*. Table 1 briefly reviews common radiotherapy acronyms and descriptions. Focusing on external beam radiation in particular, technology has allowed for innovative ways to provide safe, efficacious treatment. One important modification is the change that has occurred from using low-energy x-rays in cobalt radiation to the utilization of high-energy megavoltage x-rays. With this change, the rays can penetrate deeper while minimizing skin irradiation and side effects. Also, traditional shielding with

TABLE 1.
A brief overview of radiation therapies

Treatment abbreviation	Treatment name	Treatment description	Common cancers currently treated
EBRT	External beam radiotherapy	Encompasses all modalities involving radiotherapy by use of linear accelerators	All radiosensitive cancers
SBRT	Stereotactic body radiotherapy	High doses in five or less fractions	Lung, spine, liver
SRS	Stereotactic radiosurgery	High dose in one fraction	Brain and spine
LDR	Low-dose radiation	Surgically, permanently placed radioactive seeds	Prostate
HDR	High-dose radiation	Outpatient procedure involving the placement and removal of highly radioactive seeds	Gynecologic, prostate, breast
IMRT	Intensity modulated radiotherapy	Radiotherapy treatment with a beam three-dimensionally shaping to the tumor by modulating the intensity	Lung, brain, prostate, gynecologic, spine, pancreas, head and neck, esophagus
IGRT	Image-guided radiotherapy	X-ray films taken on the treatment table to verify patient position prior to treatment	Lung, brain, prostate, gynecologic, spine, pancreas, head and neck, esophagus
CBCT	Cone beam computer tomography	An IGRT technology using multiple x-rays from different angles that are merged by the computer to generate a three-dimensional image to verify patient position prior to treatment	Lung, brain, prostate, gynecologic, spine, pancreas, head and neck, esophagus