PALLIATIVE CARE NETWORK OF WISCONSIN

FAST FACTS AND CONCEPTS #65
RADIATION FOR PALLIATION—PART 1

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Background Radiation therapy (XRT) is used with palliative intent to improve quality of life by improving function and/or diminishing symptoms – most commonly pain, bleeding, or pressure on vital structures. This *Fast Fact* describes the physiology and methods of delivering radiation therapy; *Fast Fact* #66 discusses common indications for and outcomes of palliative XRT.

How it works XRT is the use of ionizing radiation to damage a cell's DNA. This can happen to a DNA molecule itself via a direct effect of the radiation (this is less common), or indirectly via an oxygen compound (OH, HOOH) which reacts with a DNA molecule (this pathway is more common). Damage only occurs in cells within the *radiation field*—the area through which the radiation beam passes. Both malignant and normal cells within the field are affected. Malignant cells are less efficient at repairing DNA damage and are, therefore, more likely to die. The goal is to design a radiation field that includes all of the tumor cells while excluding as much normal tissue as possible.

Types of radiation therapy XRT can be delivered 1) from outside the body as *external beam radiation* (EBRT*)*, 2) from within the body by placement of a radiation source near the cancer (*brachytherapy*), or 3) as a radio-pharmaceutical given by mouth (e.g. iodine-131) or by intravenous injection (e.g. Strontium^{89}).

Fractionation In EBRT patients typically receive one fraction per day, but other schedules are sometimes used (e.g. *hyperfractionation*, or at least 2 doses per day). *Fractionation* takes advantage of the different rates at which malignant and non-malignant cells repair damage caused by XRT; it gives normal tissues an opportunity to recover while continually reducing the tumor cell population.

Dosing Radiation doses are described in units called *Gray* (Gy) or *centiGray* (cGy): 1 Gy = 100 cGy. Note**:** in the older literature, the term *rad* was used: 1 rad = 1 cGy. A *radiation prescription* includes the site being treated, beam orientation and number (e.g. two beams, AP and PA), beam type (photons or electrons) and energy (in Volts), dose per fraction (typical daily doses for palliative EBR range from 150-400 cGy), number of fractions per day, and total dose. A *radiation boost* is an extra dose of radiation, given during the last treatments, to a smaller field within the original field. The total administered dose is based on a balance between giving enough radiation to control the tumor while respecting normal tissue tolerance to minimize the risk of late side effects. Different tissues have different radiation tolerances; liver and kidney can only tolerate a small total radiation dose (< 2400 cGy), whereas bone and peripheral nerves can tolerate much larger total doses (>5000 cGy).

Simulation Prior to the first treatment, patients undergo *simulation*, where the exact location of the field is mapped. Permanent or temporary marks are placed on the skin to help ensure that the treatment field can be reproduced in the same location at every treatment. Various types of immobilization ranging from standard pads, head cups to customizable devices are utilized depending on the clinical situation.

Delivering EBRT If the radiation prescription calls for daily fractions, patients come to the radiation therapy department once a day, five days a week. While most XRT regimens for curative intent often last 5-7 weeks, most palliative XRT regimens can be condensed to a shorter range of one day (e.g. to relieve pain from bone metastases) to three weeks. Treatments are delivered inside a shielded, enclosed room. A radiation therapist operates the radiation machine (typically a linear accelerator) from outside the room while watching the patient on a camera. Each daily treatment takes only a few minutes and is painless.

Toxicity At least once a week patients see the radiation oncologist to evaluate response and assess/treat toxicity. Toxicity depends upon the area being treated and, except for fatigue, is limited to tissues within that field. Early/acute toxicities occur during or shortly after treatment and resolve within one to two months (e.g. oral mucositis during oral radiation). Late toxicities occur months to years after treatment (e.g. coronary artery disease following chest radiation). Early toxicity is related to inflammation and death of rapidly dividing cells (such as in the skin or gastrointestinal tract), while late effects result from vascular changes and cell death of slowly

dividing cells. Radiation oncologists have a host of medications, salves, and mouth rinses to help alleviate acute toxicities (see *Fast Facts* #121, 130, 185).

References

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