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RadOnc Student Scan

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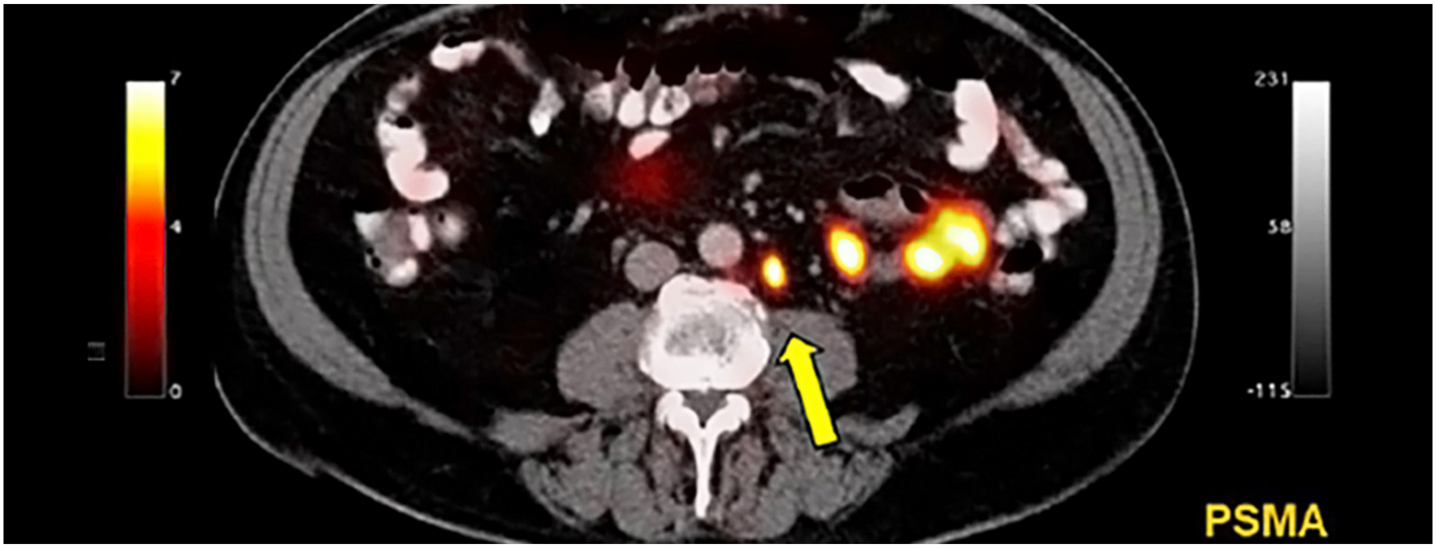

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Getting to Know More About Radiation Oncology

Sharper Than a Knife: An Introduction to Stereotactic Radiosurgery

In 1951, Lars Leksell saw radiation as not just a ray of light, but as a tool that could be used to ablate hard-to-reach tumors in the brain.[1] Traditional treatment involved whole-brain radiation therapy (WBRT), which exposed the entire brain to harmful rays of light that could lead to adverse neurological effects. Leksell introduced the concept of stereotactic radiosurgery (SRS), a highly accurate and effective form of radiation therapy that could target remote tumors without harmful side effects. SRS uses multiple converging rays of light including x-rays, gamma rays, or protons to ablate a predetermined target volume. The target volume using stereotactic radiation therapy has steep margins of energy dissipation, which limits toxic amounts of radiation from reaching surrounding tissue. Within the target volume, radiation induces DNA damage and apoptosis of various cells by exciting ions and forming free radicals. Due to the highly vascular nature of tumors, subsequent endothelial cell apoptosis and microvascular dysfunction starve tumors of nutrients needed for rapid growth.

Whether alone or in combination with other therapies, SRS can put an end to a tumor's ability to survive. One study involving 188 patients with 218 meningiomas showed that SRS is noninferior to surgical resection for treating meningiomas.[2] They also showed that it is useful for long-term tumor control and low rates of mild morbidity. Another study showed that WBRT in combination with SRS resulted in better tumor local control and improved survival vs WBRT alone in a select group of patients with favorable prognostic factors.[3] SRS using gamma rays, also known as gamma knife radiosurgery, has been used for symptomatic relief for patients with trigeminal neuralgia.[4] These advancements show how a diverse range of cancerous and noncancerous pathologies could be managed with radiation therapy.

Sculpting Success: SBRT's Effective Approach to Cancer Care

Stereotactic body radiation therapy (SBRT) is a variant of stereotactic radiosurgery delivered in smaller doses, or fractionations, each day over several weeks.[5] SBRT can be subclassified into different forms, including a linear accelerator (linac) and proton beam. Linac radiation therapy uses x-rays, or photons, to ablate tumors. Proton beam radiation therapy uses protons to treat tumors that have either already undergone radiation therapy or are near vital organs. Another SBRT technique, called CyberKnife (Accuray) uses larger doses of radiation therapy in fewer fractionations, known as hypofractionation, to treat tumors with ultrahigh precision like a surgeon's scalpel.[6] One study showed that SBRT was effective at local control in a patient with unresectable tumors of the pancreas and margin-negative resection in patients with borderline resectable pancreatic cancer.[7] These results have expanded the use of radiation therapy in patients with pancreatic cancer along with improving the outcomes of surgical intervention. Another study compared the side effect profiles of photon vs proton beam SBRT in the treatment of early stage lung cancer.[8] They found that although more patients underwent proton beam SBRT for having a higher risk of radiation pneumonitis, both techniques resulted in similar oncologic outcomes and toxicity profiles. The rates of radiation pneumonitis did not differ between techniques. This finding is in juxtaposition to previous studies that used smaller samples of patients. A systematic review found that CyberKnife is an effective treatment option in patients with unresectable head and neck carcinoma with previous exposure to radiation.[9] However, a lack of homogenous data and number of studies on this topic prevented completion of a meta-analysis. These studies have shown that SBRT and CyberKnife are being used to treat various cancer types with promising results. More exciting news about radiation therapy is yet to come as we edge closer to a world with ultrahigh precision and optimized radiation exposure.

The Patient Perspective: Expectation vs Reality in Radiation Treatment

Fears and misconceptions about breast radiation therapy (RT) are widespread among patients. However, as highlighted by Shaverdian et al,[5] the actual treatment experiences of patients are generally better than their initial expectations. In fact, most patients agreed that their initial negative impressions and fears about breast RT were unfounded. These patient-centered findings are important for counseling future patients and health care providers about the realities of modern breast RT. Previous studies have documented that women have concerns and fears about breast RT, which can influence their treatment decisions. Despite proven benefits of breast conservation therapy, eligible patients are increasingly opting for mastectomy. The study found that many patients had little knowledge about RT but had heard frightening stories about its side effects. However, among patients treated with breast conservation therapy, only a small percentage found the negative stories to be true, and the majority found their RT experience to be

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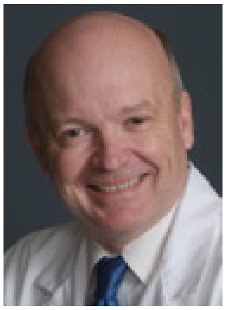
Interview With a Radiation Oncologist: Ronald C. McGarry, MD, PhD



Ronald C. McGarry, MD, PhD, clinical professor, Department of Radiation Medicine, University of Kentucky

About Dr. McGarry

First and foremost, I am driven by research and the discovery of new information. My background was biology with an MSc in zoology followed by a PhD in immunology, both at the University of Western Ontario. I then did postdoctoral research studying natural killer cells and neuroimmunology at Queen's University in Ontario. My first faculty position was at the University of Calgary, Alberta, Canada. My interest in lung cancer began during my postdoc years when I was using small cell lung cancer cells in tissue culture as a neuroendocrine control in some of my work. I found this cancer fascinating in its biology and how deadly it was to patients. I was a lab guy, and my interest was in the nuts and bolts of research – tissue culture, animal work, etc. Unfortunately, running a research lab is heavily driven by the search for grants, which I was pretty successful at but found boring. I began to seek other interests and applied to medical school in Calgary. Since I had good funding from the National Cancer Institute of Canada, I kept the lab open while going to med school. The mainstay of my research was lung cancer and my goal of attending med school was to expand my research interests and open doors.

I then completed a year's internship in internal medicine at McMaster University, not a fun year since my goals were cancer research. While there I became interested in radiation oncology since it is a specialty that focuses on patients and cancer biology. In Canada the process was different than the US at the time and I returned to the London Regional Cancer Centre to focus on radiation oncology.

Medicare in Canada is not a great system. As a resident, I saw the rationing of health care with wait lists of up to 16 weeks for patients to begin cancer treatment. That, combined with my desire to continue research, prompted my move to the US, ultimately Indianapolis.

I did not want to run a lab, but to collaborate with any and all researchers with a focus on clinical trials. Long story short, we began the stereotactic body radiation therapy (SBRT) project in Indianapolis and, given my interest in lung cancer, it was a natural fit. It was successful beyond what I expected, and I knew it was an important project.

The Future of Radiation Oncology

The very basics: There is something called the Goldie Coldman hypothesis that basically says the somatic cell mutation rate for cancer is very high to the point that when you have a mass of 103 cells, one cell is likely chemoresistant or can metastasize. Bear in mind that a 1.0-cm mass of cancer has on average 109 cells. Most CT scans for cancer screening cannot detect cancer masses < 8-10 mm or 1 cm, making screening somewhat problematic. Another challenge is multidrug resistance.

Secondly, the use of program death ligand (PDL) agents to try to "turn on" an immune response to cancer is only modestly successful for all the reasons above. It appears that there is immune surveillance against cancer that helps destroy newly arising cancer cells that appear all the time in our bodies (eg, natural killer cells). Cancer may be a failure of immune surveillance, which is why more cancers are present in older people as aging results in the breakdown of immune surveillance. That is the simplistic model. If anyone thinks a single mode of immunological regulation can break immune tolerance to cancer cells, they are incorrect. Our understanding of the immunology of cancer remains primitive. Most patients who respond to immunotherapy eventually fail due to mutation rates of cancer cells.

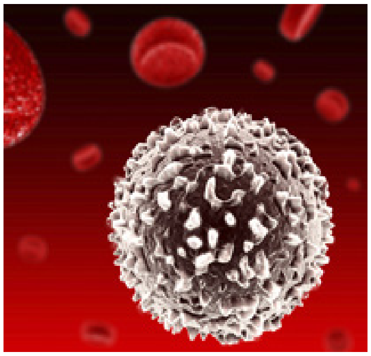
Other forms of therapy include radiopharmaceuticals. It is difficult to get the radiopharmaceutical into a mass of cells with hypoxic centers, which are often resistant. Some forms of radiopharmaceuticals involve targeting mutations in cancer cells, but other mutations may consequently arise.

What does this have to do with radiation oncology? In short, to "cure" someone of cancer you need to break down the problem in at least two ways: the gross disease (ie, masses of cancer) and microscopic disease (ie, metastatic disease). Gross disease is a big problem since cancer can sometimes outgrow our treatment due to the tumor burden. This can be addressed by surgery to remove gross disease or by focused radiation. We have developed new elegant tools in radiation oncology such as intensity-modulated radiation therapy (IMRT) to lessen risks and side effects, and treat gross and microscopic disease. For localized gross disease, SBRT is a topic at the forefront of cancer treatment.

We are also treating noncancer patients who have tachyarrhythmias that are not responsive to typical SBRT treatment. In other words, we are using SBRT to treat the heart of patients who would die otherwise of heart disease with paroxysmal tachycardia. This is an exciting new field I am involved in here in Kentucky.

For potential students, the future of radiation therapy is very bright.

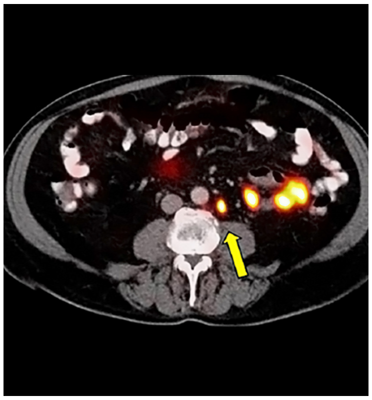
Hot Topics in Radiation Oncology



Ablative Radiation Therapy for Locally Advanced Pancreatic Cancer: Techniques and Results[12]

Radiation Oncology, Marsha Reyngold, Parag Parikh, Christopher H. Crane

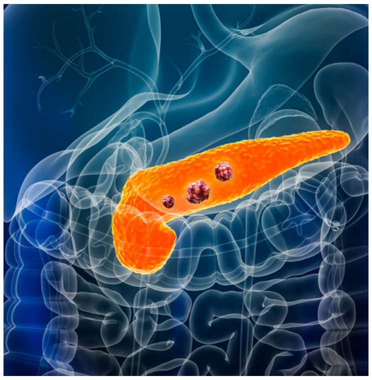
Standard dosing protocols for locally advanced unresectable pancreatic cancer includes low doses of 3- to 5-fractionations of radiation. This results in a small improvement in median survival with little toxicity and shorter treatment duration for the patient but fails to produce a significant difference in survival at 2 years or later. A larger biologically effective dose (BED) is needed to successfully ablate a tumor of the pancreas, but this presents a new problem. Large doses of radiotherapy near a highly sensitive gastrointestinal tract can result in harmful side effects. However, recent advancements in advanced organ motion management systems, image guidance, and adaptive planning techniques allow radiation oncologists to use higher doses of radiation (> 100 Gy BED) to ablate tumors in hard-to-reach areas of the body. This article explores the use of cone beam CT image (CBCT) guidance and online adaptive MRI guidance with SBRT to accurately ablate pancreatic tumors.



Advances in Radiation Oncology for Pancreatic Cancer: An Updated Review[13]

Cancers, Jason Liu, Percy Lee, Heather M. McGee, et al

This study sought to understand the evolving role of radiotherapy in locally advanced pancreatic cancer (LAPC) by systematically searching MEDLINE/PubMed and Clinicaltrials.gov for prospective and retrospective studies and metanalyses. They found that dose escalation in LAPC resulted in improved overall survival. Newer methods for delivering higher doses of radiation to hard-to-reach areas and avoiding sensitive organs at risk of radiation included SBRT, ablative hypofractionation using simultaneous integrated boost (SIB) technique, MRI guidance, or proton therapy. Using radiosensitizing agents has also shown promising results in many prospective studies. Several randomized controlled trials incorporating multi-drug regimens, such as FOLFIRINOX and immune checkpoint inhibitors, as part of neoadjuvant radiotherapy to treat resectable and borderline resectable pancreatic cancers, are underway.



Neoadjuvant Chemoradiotherapy Versus Upfront Surgery for Resectable and Borderline Resectable Pancreatic Cancer: Long-Term Results of the Dutch Randomized PREOPANC Trial[14]

Journal of Clinical Oncology, Eva Versteijne, Jacob L. van Dam, Mustafa Suker, et al

In 2013, a four-year multicenter phase III trial called PROPANC was designed to compare patient outcomes from treatment with neoadjuvant chemoradiotherapy followed by surgery and adjuvant gemcitabine vs upfront surgical resection and adjuvant gemcitabine for the treatment of resectable and borderline resectable pancreatic cancers. Neoadjuvant-chemoradiotherapy included three cycles of gemcitabine combined with 36 Gy radiotherapy in 15 fractions during the second cycle followed by surgical resection and four cycles of adjuvant gemcitabine. Patients who underwent upfront surgical resection underwent six cycles of adjuvant gemcitabine chemotherapy. Initial results failed to show a statistically significant improvement in overall survival between the neoadjuvant-chemoradiotherapy and upfront surgical resection groups at a median follow-up period of 59 months. The overall survival benefit of the neoadjuvant-chemoradiotherapy group was 15.7 months vs 14.3 months in the upfront surgical resection group (hazard ratio, 0.73; 95% CI, 0.56 to 0.96, P = 0.025). However, the 5-year survival rate of the neoadjuvant-chemoradiotherapy group was 20.5% vs 6.5% in the upfront surgical resection group. This new finding means that neoadjuvant gemcitabine-based chemoradiotherapy followed by surgical resection and adjuvant gemcitabine improves overall survival compared to upfront surgical resection and adjuvant gemcitabine in resectable and borderline resectable pancreatic cancers.

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The Patient Perspective

less scary than expected. Similar positive experiences were reported by patients treated with mastectomy. Patients found that the severity of short-term and long-term side effects of RT were generally less than expected. Advances in breast RT have addressed many initial fears expressed by patients, such as organ damage and skin burning, but public perceptions have not kept pace with these advancements. This study suggests that patient perceptions of breast RT have improved due to the significant progress in reducing toxicities and improving convenience. Overall, the study underscores the need to address misinformation and fears surrounding breast RT and emphasizes the positive experiences reported by patients, which should be considered in patient counseling and decision-making.[5]

The Ever-evolving Role of Radiation in Prostate Cancer Treatment

Radiation therapy is continually making strides to provide better care and quality of life for cancer patients. Historically, radiation therapy has been a well-tolerated form of prostate cancer treatment with an extended course of 6-8 weeks of daily treatments; now SBRT has been accepted as a standard of care for prostate cancer with only 5 treatments showing similar results.[10] This reduces patients' personal time committed to the overall delivery of care. In addition, by using hypofractionated radiation therapy, it is possible to have shorter treatment times, allowing for a lower burden of cost on the health care system.[11] By continually improving treatment regimens in radiation oncology, the health care system will benefit as will patient life. This demonstrates the ever-evolving role of radiation therapy as a key component of oncology care.

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ARO INSIGHTS

Climbing the Ladder

"Goals are good, goals are important, but goals get too much credit. Once we achieve a goal, the time spent in that feeling of victory is relatively brief compared to the time spent getting there."

Read more about Dr. Kyra N. McComas' blog post at appliedradiationoncology.com/aro-blog.com.

EPISODE 3

Does Terminology Differentiate Treatment Intent in Metastatic Cancer?

Jennifer Matsiu, a 4th-year medical student at Ohio State, and Memorial Sloan Kettering's **Dr. Kaitlyn Lapen,** discuss confusion and solutions surrounding SBRT vs SABR terminology and its impact on metastatic cancer treatment decisions.

Opportunities

Radiation Oncology Education Collaborative Study Group (ROECSG)

Includes the following:

- Undergraduate medical education (UGME), graduate medical education (GME), continuing medical education (CME), patient education, and interprofessional education groups
- Annual spring symposiums
- Online resources about global health, clinical information, study materials, and more
- Social media and blogs
- ROECSG report (visit roecsg.org/roecsg-report for latest issue)

Learn more by visiting roecsg.org/.

Upcoming Conferences

MSK 2023 Hands-On Rectal MRI Workshop
November 9, 2023 | New York, NY

Multidisciplinary Thoracic Cancers Symposium
November 30 - December 2, 2023 | New Orleans, LA (& Online)

ASCO Gastrointestinal Cancers Symposium
January 18-20, 2024 | San Francisco, CA (& Online)

ASCO Genitourinary Cancer Symposium
January 25-27, 2024 | San Francisco, CA (& Online)

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