First Gamma Knife Icon arrives in Texas
New radiosurgery tool allows frameless treatment option for brain cancer and metastases.

For decades, Gamma Knife radiosurgery has been the gold standard for cancer patients with inoperable brain tumors or brain metastases. With highly precise delivery of gamma rays, the system can also eliminate arteriovenous malformations and certain other pain and movement disorders that originate in the brain.
Until now, Gamma Knife treatment has been a single-day procedure that required the attachment of a head frame to the patient’s skull to prevent movement during treatment. But now a frameless system installed at UT Southwestern will free patients from the head frame and allow multiple treatments over several days.

The new Gamma Knife Icon, which specialists this month began using to treat patients in the Annette Simmons Stereotactic Treatment Center at Zale Lipshy University Hospital, is designed to allow stereotactic radiosurgery without placement of a frame. It uses cone beam CT imaging to verify patient positioning prior to treatment and continuous monitoring to further ensure submillimeter accuracy throughout treatment delivery.

“Our new Gamma Knife Icon, the sixth and latest generation of the device, is specifically designed to deliver a highly effective dose of radiation to an intracranial tumor or vascular malformation with the lowest possible radiation exposure to the surrounding normal brain and cranial nerves,” says Bruce Mickey, M.D., Professor of Neurosurgical Surgery. “This emphasis on brain protection, one of the founding principles of the UT Southwestern Peter O’Donnell Jr. Brain Institute, drove the decision to upgrade to this technology.”

The new Gamma Knife Icon will enable patients to receive treatments over the course of several days, rather than in just one session.

“Radiation is more tolerable to normal tissues if given in multiple, smaller daily doses called ‘fractions’ as compared to single potent doses called radiosurgery,” says Robert Timmerman, M.D., Professor of Radiation Oncology and Director of the stereotactic center. “Some targets in patients are close to or even intermingled with normal tissue, making radiosurgery difficult to tolerate. Fractionating the treatment can be useful in these circumstances.”

Previous versions of the Gamma Knife could not feasibly deliver fractionated treatments because the rigid head frame could not be put on daily or left on for many days.

The updated Gamma Knife offers several other advantages, including an expanded treatment area that includes the face and upper neck, as well as the ability to deliver staged treatments in which only a portion of the total target is treated.

The new technology will be particularly advantageous for patients with brain metastases who, more and more at UT Southwestern, are being treated with radiosurgery instead of whole-brain radiation.

“Combining the Gamma Knife Icon with our new CyberKnife gives us a full suite of capability to treat central nervous system disease with precision unmatched anywhere in North Texas,” Dr. Timmerman says. Dr. Mickey holds the William Kemp Clark Chair of Neurological Surgery. Dr. Timmerman holds the Effie Marie Cain Distinguished Chair in Cancer Therapy Research.

Each physician in the Department of Radiation Oncology specializes in the treatment of a particular cancer type, enabling individual specialists to bring familiarity and expertise to each patient encounter. They also participate in larger disease-oriented teams within UT Southwestern’s Simmons Comprehensive Cancer Center, in which physicians and scientists bring a multidisciplinary approach to bear on the scientific and clinical challenges unique to different cancers.

Our nine teams and their specialists are:

**Breast**
- Nathan Kim, M.D., Ph.D.
  - Assistant Professor
  - Trained: Vanderbilt University Medical Center

**Gastrointestinal**
- Jeffrey Meyer, M.D., M.S.
  - Associate Professor
  - Trained: Duke University Medical Center

**Genitourinary**
- Neil Desai, M.D.
  - Assistant Professor
  - Trained: Dell Family Scholar in Clinical Care
  - Kettering Cancer Center

**Central nervous system**
- Tu Dan, M.D.
  - Clinical Instructor
  - Trained: University of Florida

**Gynecologic**
- Kevin Albuquerque, M.D.
  - Assistant Professor
  - Trained: University Hospital at the University of Florida

**Head and neck**
- Thad Long Pham, M.D., Ph.D.
  - Assistant Professor
  - Trained: University of California, San Diego

- David Sher, M.D., M.P.H.
  - Associate Professor
  - Trained: Harvard Medical Center

- Tobin Strom, M.D.
  - Assistant Professor
  - Trained: University of South Florida College of Medicine

**Lung**
- Hak Choy, M.D.
  - Chair and Professor, holder of the Nancy B. & Ida L. Henson Distinguished Chair in Therapeutic Oncology Research
  - Trained: Ohio State University Hospital; UT Health Science Center at San Antonio

- Panchuth Yengar, M.D., Ph.D.
  - Assistant Professor
  - Trained: UT MD Anderson Cancer Center

**Pediatric**
- Larry Kun, M.D.
  - Professor
  - Trained: Pennrose Cancer Hospital

**Oncologic**
- Michael Folkert, M.D., Ph.D.
  - Assistant Professor
  - Trained: Memorial Sloan Kettering Cancer Center

**Ocular and other head/neck**
- Nhat-Long Pham, M.D., Ph.D.
  - Assistant Professor
  - Trained: University of California, San Diego

- David Sher, M.D., M.P.H.
  - Associate Professor
  - Trained: Harvard Medical Center

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  - Assistant Professor
  - Trained: University of South Florida College of Medicine
New doctors to focus on patient care, research

Five physicians have recently joined the patient care team of the Department of Radiation Oncology:

Zabi Wardak, M.D., Ph.D., joins as Assistant Professor and member of the team treating head and neck cancer. Dr. Wardak graduated with distinction from the University of Virginia, where he earned degrees in biochemistry and biology. He then entered the medical student training program at University of Iowa, where in addition to earning his medical degree he earned a Ph.D. in immunology. He completed his residency in radiation oncology at the University of California, San Diego.

Nhat-Long Pham, M.D., Ph.D., joins as Assistant Professor, focusing on treating breast cancer patients. He earned a master's degree in biomedical engineering at Johns Hopkins and then a combined M.D./Ph.D. at Boston University. He then completed a residency in radiation oncology at Vanderbilt University Medical Center.

Tu Dan, M.D., graduate of Thomas Jefferson University in Pennsylvania. In addition to seeing patients, Dr. Dan is also engaged in research in the laboratory of Howard Hughes Investigator Joshua Mendell, M.D., Ph.D.

Nathan Kim, M.D., Ph.D., has joined the faculty as Assistant Professor. An experienced and board-certified radiation oncologist, Dr. Kim will have a primary focus on treating breast cancer patients. He earned a master's degree in biomedical engineering at Johns Hopkins and then a combined M.D./Ph.D. at Boston University. He then completed a residency in radiation oncology at Moffitt Cancer Center in Tampa, Florida. A widely published and dedicated researcher, his practice will also focus on treating head and neck cancer as well as skin malignancies.

Instructor Tu Dan, M.D., is a member of the team focused on treating CNS disease. After graduating from the University of Florida College of Medicine, he completed a residency in radiation oncology at Thomas Jefferson University in Pennsylvania. In addition to seeing patients, Dr. Dan is also engaged in research in the laboratory of Howard Hughes Investigator Joshua Mendell, M.D., Ph.D.

Jiang garners $4m for heavy ion research

Steve Jiang, Ph.D., Professor and Vice Chair of Radiation Oncology and Chief of the Division of Medical Physics and Engineering, has been awarded a $4 million grant by the Cancer Prevention and Research Institute of Texas (CPRIT). His project is titled “Towards Carbon Beam Stereotactic Body Radiation Therapy (C-SBRT) for Higher Risk Early Stage Lung Cancer.”

“One of the focuses of our future carbon ion therapy center is to transform lung cancer treatment by delivering carbon beam SBRT (C-SBRT) for higher-risk, early-stage lung cancer,” Dr. Jiang says.

“Before we can start conducting clinical trials, we need to develop novel and carbon therapy-specific technologies to realize lung cancer C-SBRT.”

The program will include three projects: 1) spectral CT for accurate patient modeling (co-PI is Assistant Professor Ming Yang, Ph.D.); 2) Monte Carlo-based treatment planning (co-PI is Associate Professor Xin Jia, Ph.D.); and 3) real-time volumetric imaging and dose reconstruction for treatment safety and adaptation (co-PI is Associate Professor Jing Wang, Ph.D.).

Says Dr. Jiang, “Upon completion, it is expected that key technologies will have been developed and we will be ready to treat patients in what is likely to be the first heavy ion facility in the U.S.”

Construction update

Work is proceeding rapidly on the new Radiation Oncology facility scheduled to open to patients in April 2017. Linear accelerators are installed, and the building exterior is finished. Visit our home page to see a live web cam of the construction site at utswwestern.com/radonc.

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More grants

• Associate Professor Sandeep Burma, NIH grant $1.6m (five years) NIH (R01) / $387,541 (two years), NIH (R21).
• Assistant Professor Asaithamby Arumugam, Ph.D., $1.6m (five years) from the NIH National Institute of Aging.

Folkert to lead residency program

Michael Folkert, M.D., Ph.D., has been charged with leading the department’s Radiation Oncology Residency Program. Dr. Folkert says he relishes the opportunity to be more closely engaged with the training of the medical residents.

“Our program has grown significantly over the last few years,” Dr. Folkert says. “I look forward to continuing our momentum in attracting top candidates and ensuring they receive a well-rounded and diverse educational experience.”

Formerly at 12 residents, the program will expand to 13 trainee positions in 2017.

New faculty appointments

• Sarah McGuire, Ph.D., DABB, joins the Physics Division as Associate Professor. She received her Ph.D. and completed postdoctoral training at Duke University. Dr. McGuire’s research has focused on incorporating functional imaging in radiation treatment planning design and response assessment.
• Andrei Pugachev, Ph.D., is a new Assistant Professor in our Physics Division. He earned his Ph.D. at Stanford University and performed his postdoctoral training at Memorial Sloan Kettering Cancer Center. Dr. Pugachev has extensive experience in molecular imaging for radiation therapy and preclinical validation of novel PET tracers.
• Molecular Radiation Biology Instructor Heeyoun Bunch, Ph.D., joins us from Harvard Medical School and will conduct her research in the lab of Associate Professor Benjamin Chen, Ph.D.
• Scientific editor Damiana Chiavolini, Ph.D., and former postdoctoral researchers Nan Qin, Ph.D., and Troy Long, Ph.D., have been elevated to the Radiation Oncology faculty with the title of Instructor.

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• Andrei Pugachev, Ph.D., is a new Assistant Professor in our Physics Division. He earned his Ph.D. at Stanford University and performed his postdoctoral training at Memorial Sloan Kettering Cancer Center. Dr. Pugachev has extensive experience in molecular imaging for radiation therapy and preclinical validation of novel PET tracers.
• Molecular Radiation Biology Instructor Heeyoun Bunch, Ph.D., joins us from Harvard Medical School and will conduct her research in the lab of Associate Professor Benjamin Chen, Ph.D.
• Scientific editor Damiana Chiavolini, Ph.D., and former postdoctoral researchers Nan Qin, Ph.D., and Troy Long, Ph.D., have been elevated to the Radiation Oncology faculty with the title of Instructor.
Takeshima T, PogLM, Laine A, Ivengar P, Vitetta ES, Haanen B. Key role for neutrophils in irradiation-induced antitu-
Oct 4;113(40):11300-11305.
resonance imaging as a prognostic bio-

Radiation therapy-recruited neutrophil damage tumor tissues and induce apoptosis (as seen in PHASIS).

BRAIN
022015-19A A phase I dose-escalation study of stereo-
 tactic radiosurgery for brain metastases without whole brain radio-
therapy
MRG-B001 Randomized phase II trial of hypofraction-
ated dose-escalated photons IMRT or proton beam therapy versus conventional photon irradiation with concomitant and adjuvant temozolomide in patients with newly diagnosed glioblastoma
042011-075 A preliminary radiologic outcome implants for the treatment of post-unresectable uterine malignancies
022015-058 Safety lead-in phase II trial of non-adjuvant SABR for HCC tumors in newly diagnosed radiologically
092013-013 Phase II trial of stereotactic ablative radiotherapy (SABR) for low-risk prostate cancer with injectable rectal spacer

LUNG
RTSG 204 Androgen deprivation therapy and high-dose radiotherapy with or without whole pelvic radiotherapy in unfavorable intermediate or favorable high-risk prostate cancer: A phase III randomized trial
122013-030 A phase II trial of stereotactic ablative body radiation therapy (SABR) for patients with primary renal cancer (RCC)
122013-041 A phase II trial of high-dose I-125 and stereo-
tactic ablative body radiation (SABR) for patients with metastatic clear cell renal cancer (mRCC); 102012-026 A phase II trial of SABR and stereotactic ablative body radiation (SABR) for patients with metastatic castrate-resistant prostate cancer (mCRPC)

PUBLICATIONS

Department News

New laboratory opens under Davis

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Continuing Medical Education

The Department of Radiation Oncology offers free Continuing Medical Education credit to readers who read the designated CME article and successfully complete a follow-up test online. You can complete the steps necessary to receive your AMA PRA Category 1 Credit(s)™ by visiting cme.utsouthwestern.edu/content/em1509a.

Exploiting the immunomodulatory properties of radiation therapy

After completing this activity, the participant should be better able to:

- Explain the immunomodulatory changes brought on by radiation therapy to a tumor microenvironment
- Differentiate between the immune-stimulatory and immunosuppressive properties of tumor irradiation
- Define the abscopal effect of radiation therapy and in what settings it is observed most commonly
- Describe the available clinical evidence in support of combining immunotherapy and radiation therapy.

Introduction

Radiation therapy (RT) is a classic treatment modality that achieves local control of various tumors by targeting a defined field of interest or disease. Hence, it is generally ineffective in controlling widespread disease and has previously had little purpose in this setting beyond palliation. Immunotherapy is an effective systemic treatment for metastatic cancer even though a large proportion of patients do not respond because of the immunosuppressive and immunosuppressive properties of cancer. However, accumulating evidence suggests that these two treatment modalities in combination may complement each other’s therapeutic impact and offer greater clinical efficacy. The combination of immunotherapy (IMT) and RT takes advantage of the demonstrated immunogenic properties of RT. Because RT is targeted directly to the tumor, it does not inherently immunosuppress the host. By not surgically removing the tumor, the body retains an antigen depot of dying tumor cells to act as in situ tumor vaccine. However, the rational combination of IMT and RT in the clinic is still in its early stages, and its use depends on further understanding of the underlying mechanisms and early immunogenic effects that RT has on the tumor microenvironment.

Radiation-induced immunomodulatory changes in the tumor microenvironment

The activation of immune cells during cancer therapy irradiation is increasingly being recognized. Leucocytes themselves are highly radiation-sensitive and likely die from apoptosis in the irradiated field. Instead, the immune-activating effects of radiation arise from tumor antigens released following tumor cell death, which are then relayed to antigen-presenting cells (APCs) and propagated to activate the immune system. RT also appears to induce changes in the tumor microenvironment that lead to the recruitment of inflammatory cells from areas outside the radiation field, resulting in an increase in immune cell infiltration and the targeting and killing of tumor cells. In a recent study at UT Southwestern, we identified neutrophils as one of the key players in mediating early inflammatory changes caused by radiation therapy in the tumor microenvironment. In this study we showed that after radiation there is a rapid infiltration of neutrophils as the first inflammatory mediator. We further showed that this is a key step because when it is prevented, anti-tumor efficacy and the radiation effect is significantly decreased. We also explored the possibility of increasing neutrophil infiltration using G-CSF (granulocyte-colony stimulating factor) – a well-known drug currently in clinical use to increase neutrophil production – which successfully increased the anti-tumor immune response and thereby the therapeutic efficacy of radiation therapy. Because RT causes local inflammation with the infiltration of neutrophils, dendritic cells (DCs) are also attracted into the tumor. In vivo studies have shown that radiation induces the release of damage (or danger)-associated molecular patterns (DAMPs) such as HMGB1, HSP, and calreticulin into the extracellular matrix, thereby promoting the recruitment and activation of APCs such as DCs. The DCs transport tumor antigens to regional lymph nodes where an adaptive anti-tumor immune response is initiated. The products of this response (T cells and antibodies) travel back to the primary and metastatic tumor sites to eliminate tumor cells (Figure 1). Furthermore, RT causes dose-dependent increases in the hypoxia-activated prodrug, calreticulin into the extracellular matrix, which expose the tumor’s p53 to evade the immune system. This, in conjunction with a demonstrated increase in the expression of tumor cell surface in response to radiation, renders tumor cells particularly susceptible to the cytotoxic activity of CD8+ T cells.

The abscopal effect as evidence of radiation-induced anti-tumor immune response

Tumor regression outside of the irradiated field has been localized treatment is called the abscopal effect, first described by Robin H. Mole in the 1950s. Until recently, the abscopal effect was poorly understood and regarded as a rare event. But a 2004 preclinical study (Demaria et al.) demonstrated that the abscopal effect was mediated by immune cells when RT inhibited distant, untreated disease. In a 2006 study, the abscopal effect was absent in immune-deficient nude mice. Likewise, the abscopal effect was eliminated when RT in combination with anti-PD-L1 and Flt3-ligand was administered to immuno-suppressed mice as compared to immunocompetent mice, suggesting that the abscopal effect is immune-mediated. In 19 in the clinic, the abscopal effect has been documented in multiple case reports in which RT to one tumor site resulted in a systemic complete response of tumor regression at metastatic sites.

Immune-suppressive properties of radiation therapy

While all these immune-stimulating properties of radiation therapy, one has to consider that the abscopal effect is not seen more frequently. In fact, the abscopal effect is so rare that it is difficult to see it outside of case reports. This is due to the simultaneous immunosuppressive properties of radiation therapy. While RT increases CD8+ T cells and DCs in the tumor microenvironment, fractionated RT can subsequently eradicate these cells, leading to tolerance. This is likely the reason the abscopal effect is seen more frequently in the hypofractionated or stereotactic radiation (SABR) dose-fractionation settings. Tumor irradiation upregulates active transforming growth factor beta (TGF-β), which in turn can increase regulatory T cell (T-reg) cells and inhibit effector T cells. Because T-reg cells are relatively more radiosensitive, their proportional increase has been documented after tumor RT. Increases in bone marrow-derived myeloid cells (MDSC) and immunosuppressive polarization of macrophages contribute to tumor proliferation and recurrence after irradiation. Radiation combined with immunotherapy has also been shown to increase the expression of programmed death ligand 1 (PD-L1) protein on the tumors and monocytes/lymphocytes, which leads to deactivation of cytotoxic T lymphocytes (CTL). Radiation therapy not only results in primary tumor regression but also causes inflammation at the site of tumor regression, thereby allowing the immune system to recognize the abscopal effect.

Radiation and immunotherapy synergy

While it is clear that the immune system plays an active role in the irradiated tumor microenvironment, the activation of a systemic immune response by RT alone usually cannot overcome the threshold of immune-suppression in the tumor microenvironment except in a limited number of cases. Therefore, a strategy that counters the immunosuppressive properties of radiation therapy and simultaneously augments its inflammatory properties will see the abscopal effect routinely and reproducibly in the clinic. In recent years, preclinical studies that combine RT with immunotherapy have been able to reliably reproduce distant tumor regression outside of the irradiation field using syngeneic mouse models of cancer, thereby validating the combination of RT with immunomodulatory agents as a promising strategy. In our own syngeneic prostate tumor model, we demonstrated that RT and a Listeria-PSA vaccine synergize to reduce tumor volume and to generate tumor-specific CD8+ T cells.

Clinical evidence for the combined use of RT and immunotherapeutics in cancer. In a retrospective analysis of 62 patients with stage II-IV breast cancer treated with preoperative (neoadjuvant) chemotherapy and RT, Krooeda et al. reported an abscopal effect in metastatic breast cancer 9 of 42 cases (21 percent) by palpation. Biopsy of the lymph nodes revealed a histopathological abscopal effect in 22 out of the 42 cases (52 percent). While the patients who experienced the abscopal effect had CD8 and CD4+ positive infiltrating lymphocytes around the degenerated cancer cells in the irradiated primary tumor, next-generation sequence analysis of the abscopal effect revealed irradiation results in the generation of antitumor immune effector cells and their trafficking to the tumor site. Wessal et al. reported that non-irradiated lymph nodes of patients with metastatic solid tumors (14 percent) with primary renal cell carcinoma (RCC) regressed following stereotactic radiation with 96 Gy (12 x 8 Gy). Of the four patients with abscopal response, three patients received nephrectomy and none were noted as having undergone chemotherapy. Notably, one patient after nephrectomy received systemic interleukin-2, whose function is to enhance CTLs. Another recent prospective study reported an abscopal effect in patients with various metastatic solid tumors (44 percent non-surgical tumor response or to respond to reversed breast cancer) following chemo-radiation therapy combined with immunotherapy using a cytokine granulocyte-macrophage colony-stimulating factor (GM-CSF) to stimulate dendritic cell maturation. Patients enrolled in this study were treated with a total dose of 35 Gy in 10 fractions, and an abscopal response occurred in 11 of 41 accrued patients (27 percent). Similarly, a recent retrospective analysis of 21 melanoma patients who received palliative RT after they progressed from receiving the anti-PD1 (nivolumab) and ipilimumab 52 percent of patients experienced an abscopal response. Importantly,
Open mask head and neck treatment using VisionRT

A recent pilot study in the Department of Radiation Oncology at UT Southwestern Medical Center found that using VisionRT technology could improve treatment accuracy and patient comfort.

Researchers Dr. Bo Zhao, a physicist and assistant professor in the Division of Medical Physics at UT Southwestern, and Dr. Shireen Hannan, the division’s lead radiation oncologist, worked on the study. They tested whether newer technology could replace rigid masks, which can cause discomfort and sometimes lead to treatment delays.

Zhao describes the masks as “completely rigid and uncomfortable.” The team hypothesized that more natural motion could be tracked using video cameras, which VisionRT technology allows.

“Surface monitoring may even offer an advantage over the closed mask because patients do move inside the mask as well,” Zhao says. “This way you can track how much movement occurs, which can provide another indication of treatment accuracy.”

Head and neck cancer is one of the most challenging areas to treat with radiation therapy because of the location of many critical structures in close proximity. “Our aim was to show the feasibility and reproducibility of this technique,” Zhao says. “To implement it requires significant physician involvement and additional planning. We hope to continue studying the potential benefits of this approach.”

Elizabeth Martinez, 42, of Irving, Texas, had been a five-year survivor of breast cancer when she was diagnosed in the summer of 2015 with stage III kidney cancer. She knew she was in urgent need of help.

“Everything goes through your mind,” Ms. Martinez says. “You’re trying to figure out what you need to do that you haven’t done. That’s when I met Dr. Hannan.”

Raqubul Hannan, M.D., Ph.D., is an assistant professor of radiation oncology at UT Southwestern and co-leader of the Kidney Cancer Program at UT Southwestern Medical Center. He is the principal investigator of several clinical trials using stereotactic ablative radiation therapy (SABR) to try to get improved results for patients with kidney cancer.

The immediate concern with Ms. Martinez’s kidney cancer was that it had developed a venous extension into her inferior vena cava (IVC). Although surgery is the only treatment proven effective for IVC tumor thrombus, it is a challenge to eradicate cancer with this presentation, and survival rates are poor. Dr. Hannan proposed to administer SABR prior to surgery to help increase the chance of surgical success as part of a clinical trial.

“Radiation is known for a property called the abscopal effect, in which radiation to one location alarms the body’s immune system and the body starts developing an immune response to cancer outside the original field of treatment,” Dr. Hannan says. “We see this primarily in the context of SABR, when a very high dose of radiation is given in just a few treatments. But this kind of response is very unpredictable, which is why we strategically combine SABR treatment with immunotherapy agents to try to trigger the abscopal response and improve the patient’s curative chance.”

Ms. Martinez enrolled in an iSABR trial in which interleukin-2 alone will see a response to treatment in which cancer stops growing or regresses, Dr. Hannan says. “In this clinical trial with combined therapy, so far we have had a 53 percent response rate.”

Ms. Martinez received a radiation dose of 25 Gy in a single treatment to one of her lung lesions and three treatments of 1.2 Gy each to another lung lesion, followed by the interleukin-2. For her, it was a winning strategy.

“Typically, about 20 percent of advanced-stage kidney cancer patients treated with interleukin-2 alone will see a response to treatment in which cancer stops growing or regresses,” Dr. Hannan reports after one year. “She’s in complete remission, meaning that we cannot find any evidence of cancer anywhere in her body. To share that result with her was truly rewarding. I believe that someday stereotactic radiation therapy combined with immunotherapy will become an integral part of the cancer treatment strategy.”

Says Ms. Martinez, “I’m very thankful that they gave me the opportunity and it worked. I feel that I have another opportunity to live and enjoy life and enjoy my family.”

Cancer survivor Elizabeth Martinez.

“Surrounding the tumor with radiation is an effective way to target cancer cells, the higher doses given in each treatment with SABR have been shown to be successful in overcoming kidney cancer.”

Elizabeth Martinez agreed and underwent five rounds of highly focused radiation therapy to her IVC tumor thrombus followed by a radical nephrectomy.

Unfortunately, when she came back for postoperative follow-up six weeks later, the cancer had spread widely to the extent it was reclassified as stage IV.

“They told me it was everywhere, in my lungs and my stomach,” Ms. Martinez recalls. “That’s when I felt … I was going to give in.”

Dr. Hannan proposed another clinical trial involving SABR, from a series called i-SABR (immunotherapy plus SABR).

“Our aim was to show the feasibility and reproducibility of this technique. To implement it requires significant physician involvement and additional planning. We hope to continue studying the potential benefits of this approach.”

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Physicians who would like to make a referral may call the Department's main clinic number at 214-645-8525 or UT Southwestern's physician referral line at 214-645-8300 (toll-free 866-645-5455) for adult patients, or 877-445-1234 for pediatric patients.

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