Dr. Kenneth Roberts, Radiation Therapy for Cancer Treatment April 18, 2010Welcome to Yale Cancer Center Answers with Dr. Ed Chu and Dr. Francine Foss, I am Bruce Barber. Dr. Chu is Deputy Director and Chief of Medical Oncology at Yale Cancer Center and Dr. Foss is a Professor of Medical Oncology and Dermatology specializing in the treatment of lymphomas. If you would like to join the conversation, you can contact the doctors directly. The address is canceranswers@yale.edu andthe phone number is 1888-234-4YCC. This evening Ed and Francine welcome Dr. Kenneth Roberts. Dr. Roberts is a Professor of Therapeutic Radiology and Medical Director of the Yale-New Haven Shoreline Medical Center, Department of Radiation Oncology. Here is Ed Chu.Chu Why don't we start off by defining for our listeners out there what radiation oncology is?Roberts Radiation therapy is actually a very old treatment. It dates back more than 100 years, but has had profound changes during my career over the last several decades. It is part of the armamentarium of treating cancers, which includes surgery, chemotherapy, and a host of other treatments, but is integrated with the main therapies of cancer management, again surgery, chemotherapy, and radiotherapy, and specialists who have expertise with those different modalities have to work together. Broadly speaking, about 50%-60% of all cancer patients will require radiotherapy at some point in their treatment course.Chu Ken, maybe to simplify things for our listeners, when you give radiation therapy, what are you actually giving, what are they being treated with?Roberts For the most part we are delivering high energy x-rays into a tumor and that causes a series of very short chemical reactions. We deposit radiation doses in the body that interact with DNA, the genetic code, to cause the desired results of killing cancer cells.Foss Are there different types of radiation therapy?Roberts Sure, radiation can be delivered externally from the body or radiation can be delivered by implanting radiation sources directly into a tumor. Most of what I do as a radiation oncologist is external radiation techniques, and these days the most common type of machine for delivering radiotherapy is called the linear accelerator, and that machine can produce high energy x-rays that we can direct into a patient's body and their disease site, orienting treatment beams coming in from different angles and having multiple beams overlapping, so that you concentrate the radiation dose to where a tumor is located.Foss Ken, folks are familiar with radiation exposure say from radioactive spills and power plants, is this the same type of radiation, or is it different?Roberts This would be different. When there are those types of radiation accidents there are4:07 into mp3 file http://www.yalecancercenter.org/podcast/apr1810-cancer-answers-roberts.mp3 radioactive materials that are released into the environment and those materials can give off a variety of different types of radiation. In this case, linear accelerators are not depositing a radioactive substance into patients or into the environment, the machine just generates high energy x-rays, so it's different in that sense.Chu Ken, over the years on the show we have talked about the use of gamma knife, or Cyberknife, can you explain to us what the difference is between gamma knife, Cyberknife, and the use of x-ray therapy via this linear accelerator?Roberts You are bringing up some of the more recent and sophisticated radiation treatment devices. With a linear accelerator one

is delivering typically a single, larger beam, to encompass a region of the body. With these newer technologies, as you mentioned gamma knife and Cyberknife, there are similarities to linear accelerators, particularly with Cyberknife, but what we are doing is delivering very small radiation treatment beams, pencil thin beams if you will, which can then be oriented to come in from different directions and angles into a tumor target and one is able to then focus the radiation dose very tightly and specifically to a tumor and deliver a very little radiation dose to nearby normal tissues.Chu So presumably then, for those types of radiation therapy treatments, the issue of toxicity might be less than more traditional forms of radiation therapy?Roberts Right, that's correct, but it depends on the circumstance when you need to use these different types of radiation treatments. If you are trying to target a very small tumor, say a single brain metastasis, it is appropriate to use a gamma knife or even a Cyberknife to deliver very focused radiation just to a very small tumor that's in the brain. On the other hand, if the goal of the therapy is to treat a broader area of the body, where there could be a microscopic burden of tumor cells, these very focused treatments are not appropriate and more traditional forms of radiotherapy are more effective and useful.Foss Are these more focused and new techniques available in all centers, or is this something that a patient would have to travel to a specific center for?Roberts They are very expensive technologies and they have limited availability at particular centers. At Yale, we have gamma knife technology for treating intracranial tumors and this is also sometimes called radiosurgery, these very focused types of radiation techniques. There has been the development of radiosurgery for treatment elsewhere in the body, called body radiosurgery, and at Yale we use a linear accelerator that has been specifically adapted for that purpose in order to treat, with these very small pencil thin beams, other problems, say a small lung cancer for instance.8:28 into mp3 file http://www.yalecancercenter.org/podcast/apr1810-cancer-answers-roberts.mp3Chu In the news there is a lot of attention being placed on perhaps the latest form of radiation therapy, proton beam radiation therapy, can you say a word or two about that approach?Roberts Sure, that's a very exciting development in the field of radiation oncology. It's also an extraordinarily expensive technology where currently it would take 200 to 300 Million dollars to set up a treatment facility. So, there are limited numbers of these photon facilities throughout the world because of the huge financial barriers, but the advantage of protons is that they lack an exit portion of the radiation beam. They also have characteristics that deposit radiation at a very concentrated amount inside the patient at a pre-determined depth depending on where the tumor is located. These physical characteristics of this type of radiation are extremely important and useful since one has the ability to reduce the exposure of normal tissues in a particular problem and reduce the complications from exposure of critical normal tissue right next to the tumor. For instance, proton therapy was used for a rare tumor called chordoma, which occurs in the base of skull right next to the brain stem, and it has been found that with the proton beam radiotherapy you are able to increase the dose of radiation one can deliver to control the disease and yet not cause profound neurologic

problems because you are able to control and eliminate doses going to the brain stem.Foss Ken, with all of these different types of radiation therapy, how do you decide what type to treat an individual patient with, is there a process that you go through?Roberts Well, that's the broad question. Obviously, it is highly individualized and dependent on the particular problem and, first of, in working in a collaborative manner with other specialists for a given cancer with a diagnosis one needs to determine the exact extent of the disease, determine the stage, and come up with a joint treatment integrating chemotherapy, surgery, and radiotherapy. So, it really depends on a whole host of factors and circumstances as to how we employ radiotherapy. It is probably best to take a concrete example, say breast cancer. Once a breast tumor is diagnosed say by mammography or a woman feeling a lump, it's biopsied and if a cancer diagnosis is established then one needs to determine if this is localized or if it has spread anywhere. If it's a localized problem, a common treatment scheme is to think about surgery to remove the lump and potentially even biopsy lymph nodes to see if there is any spread. With that information one can then determine the extent of disease and then decide whether systemic therapy or chemotherapy or hormone therapy is going to be necessary, and then radiotherapy has a role in that sort of situation to help with controlling the disease within the breast and potentially within the lymph nodes in the vicinity of the breast. Over the last several decades, radiotherapy for this particular problem has been shown to allow for less extensive surgery to be performed, so rather than a mastectomy, often times women just need to undergo an excisional biopsy, or so called13:37 into mp3 file http://www.yalecancercenter.org/podcast/apr1810-cancer-answers-roberts.mp3lumpectomy, and then radiotherapy allows for treatment that avoids more disfiguring surgery. And of course there are sometimes reasons why mastectomy is important and sometimes after mastectomy radiotherapy still needs to be given in order to prevent recurrence in lymph nodes.Foss Ken, I would like to talk in a little more detail about combining say chemotherapy with radiation therapy when we come back after the break. We have to take a short break now for a Medical Minute. Dr. Kenneth Roberts is speaking with us today about radiation therapy.Foss Welcome back to Yale Cancer Center Answers. This is Dr. Francine Foss and I am here today with Dr. Ed Chu, my co-host, and our guest Dr. Kenneth Roberts who joins us to talk about radiation oncology. Ken, before the break you gave us a scenario of a woman with breast cancer who was treated with combined modality therapy and often times we use radiation in conjunction with other therapies. Can you talk about the interaction between say chemotherapy and radiation therapy?Roberts Sure, in the case of breast cancer, chemotherapy, or hormone therapy depending on the circumstances, is used to treat any potential spread throughout the whole body as well as any disease that could be localized to the breast or regional lymph nodes, and radiotherapy is used as a localized treatment, or a local regional treatment, to treat where there is a higher burden of the disease and compliment the chemotherapy. Now, in the case of breast cancer, we usually give treatments sequentially, often time's chemotherapy or systemic therapy is given first and then the radiotherapy later. There are other circumstances where clinical trials

have shown that giving chemotherapy and radiation at the same time is of benefit and that there is favorable interaction between the two modalities where you get an enhanced killing of tumor cells and hopefully in these circumstances, less side effects.16:59 into mp3 file http://www.yalecancercenter.org/podcast/apr1810-cancer-answers-roberts.mp3Chu Are there any cancers where radiation therapy is considered the treatment of choice upfront, as opposed to combining radiation with chemotherapy?Roberts Radiotherapy is the primary treatment for a number of diseases, certain lymphomas come to mind, and prostrate cancer is another example, historically.Chu That would be early stage prostate cancer?Roberts Correct, and cervical cancer is another example, although in the case where we employ radiotherapy as a primary treatment, it's in more advanced stages or locally advanced instances where surgery is not feasible.Foss Ken, we talked a little bit about potential complications of radiation therapy on normal tissues. Can you elaborate a little bit more about that?Roberts Different normal tissues throughout the body are going to have a different tolerance for the effects of radiation and the radiation oncologist has a knowledge base of what each individual clinical circumstance warrants, what normal tissues are nearby a tumor and what that normal tissue can tolerate. An example is say a lung cancer, where one has to be cognizant of how much radiation the normal lung tissue, or the heart, or the esophagus, the swallowing tube, can tolerate and that's an important consideration in how we design radiation and treatment.Foss I don't think our listeners fully appreciate how much work goes on behind the scenes in terms of planning these radiation fields and shielding normal tissues.Roberts Well it is a considerable amount of work as you appreciate, but in the planning process for radiotherapy once we have decided that radiotherapy is going to be part of the treatment plan, a patient will undergo a planning session for radiotherapy. Oftentimes these days, this includes a CAT scan obtained in the radiotherapy department in the position that the patient is going to be treated in. That allows us to use some computer systems in which we are able to simulate how the radiation is going to be delivered, how the individual beams are going to be oriented, and then how we might be shaping or blocking each beam in order to minimize just the normal tissues. It's a very technologic process these days and as computers and imaging technologies has been improving over the last several decades, those advances have been applied to the field of radiation oncology to the benefit of patients. We are able to be much more specific with the delivery of radiation treatments and be more effective, and I think also produce fewer side effects.21:00 into mp3 file http://www.yalecancercenter.org/podcast/apr1810-cancer-answers-roberts.mp3Chu Ken may be you can just review, you know, briefly on what are some of the common immediate side effects associated with radiation therapy?Roberts Sure, and that's highly dependent on what part of the body we are treating, but as a general concept radiotherapy side effects have an immediate or an acute phase and the more concerning effects from radiotherapy are often what could occur many months to years later in sort of a late phase. I also should mention that one of the common things that we do with radiotherapy to reduce side effects is to break it up into small amounts, given on a daily basis. That process of fractionation capitalizes on differences and how tumors

and normal tissues react to radiation and have a much more specific effect on killing tumor cells and fewer side effects. The acute side effects of radiotherapy often include feeling tired, and skin reactions are common, but it really depends on specific circumstances and skin reactions have played an increasingly smaller role in complications of radiotherapy with modern technologies in the way we are able to aim the radiation beam. Otherwise, the acute effects of radiation have a lot to do with which mucosal surfaces or epithelial surfaces are nearby what we are treating.Chu In general, do people loose their appetite, have nausea, vomiting, like the total side effects with chemotherapy?Roberts It really depends on what part of the body is being treated. If it is an abdominal site then yes, sometimes we can see nausea and sometimes we can see diarrhea because of the effects on the intestines. Problems with nausea are typically extremely well controlled with adjunctive medications, anti-nausea medicines, just as has been seen with chemotherapy, so nausea and vomiting usually are very controlled and are no longer a limiting factor in cancer treatment.Foss Ken, you said that there is a different period of time for each treatment depending on the disease, but what's the average period of time that a patient undergoes radiation therapy, for say a solid tumor like a pancreatic cancer or colon cancer?Roberts Well for those specific examples of gastrointestinal tumors, when we are treating with curative intent, usually radiotherapy is being given as an adjunct along with chemotherapy and surgery and often times we are looking at roughly a 5 week course of daily treatments, Monday thru Friday, but another circumstances, say if the intent is to relieve symptoms or palliate a patient's disease process, a shorter course of therapy is used since the goals are much different than trying to cure the patient. For instance, if there is a problem with pain or a tumor that is bleeding or causing obstruction of an airway and causing difficulty breathing, those are instances where these radiotherapies are very powerful to relive symptoms and25:13 into mp3 file http://www.yalecancercenter.org/podcast/apr1810-cancer-answers-roberts.mp3those treatment courses are typically a lot shorter and might be anywhere from a week to three weeks, daily treatment.Chu A moment ago you mentioned the issue of acute versus long term side effects of radiation therapy. I know some of those long-term consequences can be pretty significant in some patients, can you tell us a little bit about what some of these long term side effects people who receive radiation therapy should be aware of?Roberts Again, that depends on the exact clinical circumstances. Probably a good example to discuss is Hodgkin's disease. That's been a highly curable disease and the use of radiotherapy was employed for the treatment of early stage Hodgkin's disease a number of decades ago and with the huge success in curing that particular lymphoma with radiotherapy, we have had many decades of follow-up to see what the consequences of radiotherapy are. For Hodgkin's disease, the way we historically treated it, and no longer treat it, was to treat a broad volume of lymph nodes throughout the body and that gave exposures to many different normal tissues, in what I term a moderate dose range, and while this cured a vast majority of patients with Hodgkin's disease, what we saw in the ensuing decade was an increased risk of other cancers developing and also, when treating the chest area, we saw an increasing risk for heart disease. From our experience, we have

changed how we use radiotherapy to not only treat Hodgkin's disease, but many other diseases, as to learn from that experience and minimize the risk for future patients. For Hodgkin's disease, I must say that there has been a general switch to chemotherapy as a primary treatment, but still using radiotherapy in more limited, lower doses, lower volumes of the body to compliment chemotherapy and give an optimal mix of chemotherapy and radiation with fewer side effects.Chu Just curious, what were those secondary cancers that were seen?Roberts Breast cancer has been a particular problem with young women treated with radiotherapy for Hodgkin's disease decades ago. The other types of secondary cancers have included thyroid cancer, lung cancer, and we are getting some sense that with the change in how we treat Hodgkin's disease with lower doses of radiation and chemotherapy that the burden of the risk of other cancers has been diminishing markedly.Chu Presumably, as you say, technologies also have dramatically improved over the last 5-10 years.Roberts Absolutely, we are able to much more specifically treat where we need to and reduce normal tissue exposures.28:58 into mp3 file http://www.yalecancercenter.org/podcast/apr1810-cancer-answers-roberts.mp3Chu Ken, it has been great having you on the show. Time ran out and we did not have a chance to talk about some of the interesting clinical research that's ongoing at Yale Cancer Center, but hopefully we will have you back on a future show.Roberts I will be glad to come back and discuss that.Chu Until next week, this is Dr. Ed Chu from Yale Cancer Center wishing you a safe and healthy week.If you have any questions or would like to share your comments, visit yalecancercenter.org where you can also subscribe to our podcast and find written transcripts of past programs. I am Bruce Barber and you are listening to the WNPR Health Forum on the Connecticut Public Broadcasting Network.