

Support for Yale Cancer Answers comes from AstraZeneca, working to change how cancer is treated with personalized medicine. Learn more at astrazeneca-us.com Welcome to Yale Cancer Answers with Drs. Anees Chagpar and Steven Gore. I am Bruce Barber. Yale Cancer Answers features the latest information on cancer care by welcoming oncologists and specialists who are on the forefront of the battle to fight cancer. This week, it is a conversation about interventional oncology with Dr. Kevin Kim. Dr. Kim is a Professor of Radiology and Biomedical Imaging at Yale School of Medicine, and Dr. Gore is a Professor of Internal Medicine and Hematology at Yale and Director of Hematologic Malignancies at Smilow Cancer Hospital. Gore So tell us what is interventional oncology, and I do not think most people think of radiology and intervention necessarily in the same sentence, at least to a lot of lay public, can you tell us about that?

Kim Yes, happy to. Steve, I think interventional oncology is probably one of the most fascinating and exciting advancements in cancer care in my mind. Interventional oncology combines sophisticated imaging advancements that we have had for a number of years now and then with those advancements in the surgical skill sets, techniques, as well as the medical treatments, all packaged together for precise cancer care. This is truly an exciting field.

Gore So, does that mean you do surgery?

Kim So, we do minimally invasive procedures. Those are nonsurgical, but yet the effects of it from many of the care are equivalent to that of surgical care.

Gore Could you give us some examples of the kinds of things that an interventional oncologist can do?

Kim Sure. So, we do a lot of treatments for patients with cancer, all the way from curative intent treatments to the combination therapy with typically systemic therapy or radiation therapy as well as the palliative care. So, as an example patients with, let us say, liver cancer with solitary liver cancer, which otherwise curative intent of treatment would have been surgical treatment, we would make quarter-inch skin access and then we deploy our very thin probe directly and precisely targeted to cancer and we activate our energy delivery and then we can essentially kill the entirety of the cancer, therefore, curative intent treatment as such. And we have multiple other treatments as such. Gore So, let me just get this right. So, you are taking a little needle and you are putting it through the skin right into the liver? Kim Correct, in case of liver cancer. Gore Okay. And then you said, you are bringing energy, what was that, what kind of energy would that be? 00:03:08 into MP3: https://cdn1.medicine.yale.edu/cancer/2018-YCA-0708-Podcast-Kim_337683_5_v1.mp3 Kim Yeah. So, over the years, there have been multiple different technologies and technological advancements of treating cancer locally. We have a full array of different treatment options. Initially, it started with chemical ablation. So, we put in chemical to destroy cancer directly at the local site. However, now, we have multiple different mechanical and electronic devices that either can heat the cancer or freeze cancer cells or electrocute or shock the cancer. Gore Wow, so like microwaving your

liver. Kim Correct. So, it is actually called microwave ablation, one of the technologies that we have. Gore And so how large a tumor can you treat with these local energy-based techniques. Kim So, there have been significant technological developments. So, what used to be very small tumor that we were able to treat, now the scope of treatments have broadened where more or less up to two quarters size, meaning twice as big as quarters that we have, that we can deliver energy effectively for cure, but also we do a lot of palliative care on larger tumors so that the patients would have less pain from the cancer itself or help out the systemic therapy concomitantly. Gore Okay, gotcha. Before we get to that, I am still interested in this two quarter thing we are talking about, what looks to me like almost 2 inches I guess. Kim Correct. Gore So, that is a pretty big-sized tumor and does the application of the energy are the patients awake during this or do you put them into twilight sleep or...? Kim Right. We do both twilight state or moderate sedation as we call it or deep sedation or general anesthesia. So, depending on what we do, where we do and how we do, the patient can choose or we can choose the right method of anesthesia for the patient. Gore Right. And it seems to me that, however you are going to be killing those tumors cells, it sounds to me like there would be some pain associated with that afterwards, am I wrong about that? Kim So, the patients do spectacularly well and though I think that is also due to technological advancements, but you will be amazed to see how well patients tolerate. Typically, we do these treatments as an outpatient. Gore No kidding. Kim Most of our patients after appropriate postop recovery, which is typically 2-3 hours, the patients go home on the same day, again with nothing but a Band-Aid over the quarter-inch skin access site where the probe was deployed, essentially completely healed, and the patients do exceptionally well after they go home. 00:06:21 into MP3: https://cdn1.medicine.yale.edu/cancer/2018-YCA-0708-Podcast-Kim_337683_5_v1.mp3 Gore It sounds like a lot easier than actually going in and cutting out a part of the liver. Kim So, for appropriate patients, our patients have done extremely well that I highly recommend this particular treatment. Gore So, when the patients are considering the various treatment options, I imagine the different practitioners will give different recommendations about whether a surgical approach or this kind of local radiologist approach is going to be appropriate. How does the patient negotiate these choices? Kim Correct. I think that is where the multidisciplinary discussion as well as care and coordinated approach are very important. So, in our case, every new patient, every patient that needs such multidisciplinary evaluations, we discuss in our tumor board which are comprised of surgeons, medical oncologists, the radiation oncologists and us – interventional oncologists, as well as pathologists and diagnostic radiologists, all together sit together and then we discuss patients to see which treatment and which treatment strategy will be the most effective and very best tolerated by the patients. Gore So, you make a group recommendation in other words? Kim Correct. So that the patients not only get expertise from one doctor, let's say mine – from interventional oncology approach, but also gets the expert opinion from everyone else in our cancer center. Gore And this kind of multidisciplinary approach to consultation is present and is available in

many top-notch cancer centers, is that right? Kim Correct. I believe so. Gore Yeah. So, I think the take-home message for our listeners are that it is maybe very useful for them to find a cancer center locally or in the nearby area where they can get this kind of a multidisciplinary consultation if there are varying possibilities for treatment and certainly this should ask their physicians, their oncologists or whomever their seeing surgeons about whether there are other modalities they should be considering, right? Kim I do agree because nowadays as well know, Steve, there are multiple different treatment options and multiple treatment strategies. Now, we often try to come out with not only the most effective therapy, but also therapy that the patient can actually tolerate and enjoy the good quality of life. And for those, I think that the multidisciplinary discussion is essential. Gore Yeah. I agree and I am always struck little sadly sometimes when people that I know have been told by whomever they are seeing that there is one way to go and it seems to me that there may be other ways to go, in which case I usually suggest perhaps they want a second opinion, but not everybody feels like they are entitled to or have the time to do that. 00:09:22 into MP3: https://cdn1.medicine.yale.edu/cancer/2018-YCA-0708-Podcast-Kim_337683_5_v1.mp3 Kim Correct, I absolutely agree. Gore So, are there interventional radiologists at most multidisciplinary discussions for all different kinds of cancer, because you mentioned the liver cancer, will there be somebody present at the breast cancer conferences or are you called in as people see fit? Kim Correct. So, it may vary depending on a cancer center and the size of the staff that each hospital and healthcare and the cancer center may have. In our case, we have a dedicated team of interventional oncologists with not only interest or focus, but the commitment to the patients with cancer care. Therefore, we have interventional oncologists at many of the tumor boards including but not exclusive of liver cancer tumor board, GI cancer tumor board, GU cancer tumor board, melanoma cancer tumor board as well as the CNS and the breast soon to be. So, I think that our patients get ample benefits of having expertise from multiple different subspecialties, including interventional oncology. Gore Excellent. For our listeners, CNS usually refers to the central nervous system, those people who are not familiar with that abbreviation. So, that is really interesting. So, your staff members, do they tend to develop particular expertise in a certain anatomical area or kind of cancer or are you all pretty flexible about what you can do? Kim So, we have the team of dedicated staff who are fully committed to care of patients with cancer. Now, we are developing our team into the specific disease process basis just as the rest of the cancer center and we have several faculty concentrating and focusing on different disease group. I think that is probably the best way to serve our patients who are cared for by multidisciplinary team in different disease group. Gore I would have to imagine that both the anatomy and the various places is different, so how you get to different areas as well as the type of cancer and the best kind of treatment, that is a lot to know. Kim Correct. So, our people not only need to have expertise in image guidance, because that is how we deliver our care at the most precise way, but also our people need to have disease expertise and the way to strategize our treatment with the rest of

other therapies, such as surgical and the systemic therapies. So, our staff are well trained, well knowledge in multiple areas but that is how we are trying to take care of our patients the best. Gore Gotcha. So, are most of the treatments that you do, you say image guided, so I guess that would mean like a CAT scan or an MRI or other PET scan or whatever, are they mostly from outside as we discussed with the liver, putting a needle through the skin or do you also sometimes go through the blood vessels like angiographers, is that a whole different area? 00:12:45 into MP3: https://cdn1.medicine.yale.edu/cancer/2018-YCA-0708-Podcast-Kim_337683_5_v1.mp3 Kim Correct. So, sort of summing it up, our care or our treatments are targeted delivery of either drug, radiation or energy to essentially to eradicate the cancer. So, when we deliver cancer drugs or radiation, we can use what we call the percutaneous approach, which is through a cannula directly through the skin, which was what we described earlier or through an artery or vein, typically through groin or the wrist area. Again, all of these patients and all of this care is done through about a quarter-inch skin nick, skin access site and our patients are typically cared for as an outpatient procedure. Gore Wow. We got lot more to talk about because there is clearly a lot on your menu and it is really a very fascinating and growing area. Right now, we are going to take a short break for a medical minute. Please stay tuned to learn more about interventional oncology with Dr. Kevin Kim. Medical Minute : Support for Yale Cancer Answers comes from AstraZeneca, a biopharmaceutical business with a deep-rooted heritage in oncology and a commitment to developing cancer medicines for patients. Learn more at astrazeneca-us.com. This is a medical minute about genetic testing which can be useful for people with certain types of cancer that seem to run in their families. Patients that are considered at risk receive genetic counseling and testing so informed medical decisions can be based on their own personal risk assessment. Resources for genetic counseling and testing are available at federally designated comprehensive cancer centers. Interdisciplinary teams include geneticists, genetic counselors, physicians and nurses who work together to provide risk assessment and steps to prevent the development of cancer. More information is available at YaleCancerCenter.org. You are listening to Connecticut Public Radio. Gore Welcome back to Yale Cancer Answers. This is Dr. Steven Gore and I am joined tonight by my guest, Dr. Kevin Kim. We have been discussing interventional oncology, and wow, I am just blown away thinking about the kinds of things you and your staff and others like you do, Kevin. There is so much to know about the anatomy, the vasculature, and the modalities. And before the break, you were talking about actually delivering chemicals to kill the cancer locally, now do you mean chemotherapy drugs? Kim So, often chemotherapy, but that field is evolving. I think that in the near future, perhaps it may include different anti-cancer drugs such as viruses or treated genetically viruses for antiviral therapy, targeted drugs or perhaps immunotherapy directly into the cancer. I think that the horizon, there is a lot exciting advancements are happening. Gore Why would you want to inject cancer drugs locally rather than give them through the vein so they can get everywhere the cancer might be, what is the advantage of doing it locally? 00:16:12 into MP3: <https://cdn1.medicine.yale.edu/cancer/2018-YCA->

0708-Podcast-Kim_337683_5_v1.mp3 Kim Yeah. So, it depends on how the patients present. As you well know, Steve, that even though we try to put our patients with cancer into different sort of stages and different "groups" to standardize our treatments, but the patients come in with all different types of cancers, in different stages with different performance statuses, so that is why we do personalized care. But in this case, there are patients who have either solitary primary cancer or oligometastatic cancer or the patients who are responding to systemic therapy but yet have progression in limited number of disease. I think that those are the areas where the curative intent of local therapy with the interventional oncologic treatments can make vast improvements, but also there are a lot of research, particularly from a basic science and translational science coming where our local therapy from interventional oncology can actually enhance that of the systemic therapy. So, I think this is a very, very exciting field. Gore Are you able to give higher doses or concentrations of the drug locally than could be tolerated if you are giving them through the vein to the whole body or is that not really the case? Kim Correct. So, this has been the studied and proven that the patients can tolerate far higher doses of anti-cancer drugs or energy locally than if you are giving systemically for the higher "the tumor kills." Obviously, the goal is effective tumor kills so that we can eradicate the cancers. Gore I know sometimes radiation oncologists put radioactive seeds or other kind of materials locally into various tumors, now do they do that with you guys or do they do that all on their own? Kim So, there are multiple treatments that both interventional oncology and radiation oncology either treat the patients separately as well as collaboratively. So, I think that what you are referring to Steve is what we call brachytherapy and such brachytherapy has been successful particularly in let us say prostate cancer. The radiation delivery that we do in interventional oncology typically use tiny little beads that are so tiny that we cannot see; however, typically, these beads that have a high level of radiation gets delivered directly into the cancers, particularly let us say in the liver cancer has been very effective in terms of delivering high doses of radiation directly into the liver tumor. Gore So, is it you that places the radiation or can it go work either way? Kim So, this since is a radiation, which is regulated that any center, it should be delivered and monitored and supervised and followed by what we call AU or authorized users. Now, authorized users depending on the institution could be interventional oncologist, radiation oncologist or nuclear medicine or any other qualified personnel in that particular hospital. Gore Gotcha, wow. So, how do you get trained to do what you do. It seems like you need to be an expert in imaging and in localizing and now maybe in handling radiation, it seems like you've got to wear 5 different hats. 00:20:00 into MP3: https://cdn1.medicine.yale.edu/cancer/2018-YCA-0708-Podcast-Kim_337683_5_v1.mp3 Kim So, there is a lot of learn, but that is why the people who are practicing and committed to such care, they need to be not only trained well but also constantly maintain their education and training. But for now, after the medical school and internship, we now have independent interventional radiology residency, which is 5 years, make sure of the training in diagnostic radiology so that they have a foundation of image

guidance and image interpretation as well as clinical medicine and the medicine of interventional care. So, those are the 5 years after internship and probably in the future there will be subspecialty training of interventional oncology. Gore I see. So, medical students who are thinking about what they want to be and applying for their post-medical school training actually apply directly into interventional radiology? Kim Correct. That is the new residency program that has started recently; however, now, it is actually one of the most popular and the most competitive field in Match. Gore No kidding. That is very interesting. Now, what about if somebody goes into radiology because I think they want to read scans and they become interested in intervention, can they then switch over into training in interventional as well? Kim Correct. There are a couple of pathways that such trainees can essentially transfer or undergo additional training in interventional radiology. Gore And are the interventional radiologists who are so trained, are they qualified to be a diagnostic radiologist at the same time? In other words, can they go out and read x-rays at a hospital or they really not qualified to do that in that way? Kim So, currently, the people who graduate from our residency have a dual certificate, one in the diagnostic radiology and one in interventional radiology. So, if they chose, they could do that; however, you will see at larger hospitals such as ours. We have dedicated interventional oncologists who will not only practice just interventional medicine but also focusing on cancer. So, the practice patterns are somewhat variable depending on the site. Gore Well, I can tell you that if I had the need for somebody to go into my liver and microwave it or freeze it, I would certainly want somebody who had been highly trained in that area. I mean, it seems kind of like a no-brainer, you would want somebody who really knows what they are doing or in the brain, for example? These are delicate structures. Kim I think such expertise do come from experience, training as well as the constant dedicated work and having such committed and dedicated people in your hospital definitely helps patient care. Gore Right. And you supervise at your institution the whole section of interventional radiology, is that right or interventional oncology? Kim Correct. I am the chief of the interventional radiology and leads Smilow Interventional Oncology program. 00:23:12 into MP3: https://cdn1.medicine.yale.edu/cancer/2018-YCA-0708-Podcast-Kim_337683_5_v1.mp3 Gore So, not only do you have to do this stuff yourself, but you are really responsible for ensuring the quality across your department. That seems like a big responsibility. Kim Correct. But we have many faculty many staffs who are doing the same as what I do now, so it makes my job a lot easier. Gore Now, are there areas of interventional radiology that do not involve cancer? Kim Correct. So, interventional radiology is a pretty large field. Of course, interventional oncology is a large part of it; however, there are many other non-cancer cares that the field does, such as vascular care, carotid artery stenosis, abdominal aortic aneurysm care, chronic limb ischemia care, but also venous disease as well as many other diseases such as taking care of patients with uterine fibroid, benign prostate hypertrophy. There are many different areas that the interventional radiology can help out patients. Gore And are there then specific interventional radiologists who specialize in those non-cancer areas or is it kind of a crossover? Kim Yeah. So,

especially in a large center like ours where we have a large group, you tend to have people who are interested in and the focus in certain disease and certain care, so we have dedicated people, dedicated staff and faculty who are committed again and dedicated to those different conditions that we treat. So, we not only care for our patients with cancer in a dedicated way but also in non-cancer conditions as well. Gore I recently met somebody, a very healthy gentleman, who developed stroke very surprisingly in Canada and I assume a radiologist went in and they actually had to, like I said, first tried to dissolve the clot, but then actually went in and retrieved the clot I guess. Again, with that kind of thing going on, I think you want somebody who really knows what they are doing? Kim Absolutely. So, you are referring to, Steve, the stroke thrombolysis or thrombectomy. For the right patient in an appropriate time, it can be a real time saver. In fact, I am sure that my mother-in-law will be happy to discuss as well, but my mother-in-law was an example or the living proof of such care of working, where she developed MCA stroke and she received the stroke thrombolysis and then thrombectomy in a timely manner and she has fully recovered and she is enjoying her life. Gore Yeah. The person I met similarly, it is like a miracle. I was so pleased to see that. What is the most exciting area of research in your field that really wakes you up in the morning? 00:26:28 into MP3: https://cdn1.medicine.yale.edu/cancer/2018-YCA-0708-Podcast-Kim_337683_5_v1.mp3 Kim So, in my mind, there are multiple, multiple different avenues where interventional oncology research are taking us to, but in my area of focus, there are two. One is, I have been explaining all of our therapies are getting more precise and less invasive, which means is more targeted to the cancer but yet is affecting much less so for the surrounding normal organs and structures, which helps our patients tremendously in terms of taking care of cancer, but yet keeping the quality of life high. But my focus area of research is immunotherapy and immune modulation, so through the laboratory research as well as translational research. We are finding every exciting data and very exciting proof that the local therapy with immune modulation in the right setting can really boost systemic therapy, especially immune therapy which I think will be wonderful advancement for our patients. Gore Can you give an example either in your laboratory experiments or potentially in a clinical study of this type of localized immune therapy. Kim So, Steve, as you well know, the systemic immune therapy has revolutionized cancer care in many of the diseases that we take care of, but at the same time, there are some patients who may not benefit from, we call that primary resistance, but also those patients who did respond to immunotherapy but yet at some point do develop resistance, so we call that acquired resistance. In our lab, we are studying particularly acquired resistance and we are finding that in the appropriate setting with the appropriate systemic immunotherapy, applying local therapy such as cryotherapy, which is freezing or heat therapy can actually modulate the immune system, both at the cancer site and the microinvolvement which is right around the cancer tissue, and it can actually affect the immune therapy benefits to the patient in a synergistic way. I think this is very, very exciting. Dr. Kevin Kim is a Professor of Radiology and Biomedical Imaging at Yale School

of Medicine. If you have questions, the address is canceranswers@yale.edu and past editions of the program are available in audio and written form at YaleCancerCenter.org. I am Bruce Barber reminding you to tune in each week to learn more about the fight against cancer here on Connecticut Public Radio.