DEVELOPMENT OF RADIATION ONCOLOGY

Dr. Gil Lederman responds to questions posed by Dr Stanley Kornhauser on the development of radiation oncology and its many innovations in the treatment of cancer.

Question: ***There is tremendous interest in technology to care for those with cancer?***

Dr. Lederman: Yes there is. In the last two decades since President Nixon declared war on cancer, there has been unparalleled activity in all aspects of research and treatment. The emphasis has gone from determining the etiology of cancer, to the development of effective drugs and new radiation technologies to treat cancer, to early detection and even prevention of malignancies.

Question: ***What has transpired in the field of radiation oncology?***

Dr. Lederman: Education and research has produced many new advances. Twenty years ago, radiation oncology was very basic. Today, it is responsible for many innovations in the treatment of cancer. Current therapy includes combination therapy, implant and stereotactic radiation.

Stereotactic radiation is a very important part of my practice. We have patients from around the world who come for precisely directed radiation. This means that types of treatment that were never imagined before can now be implemented. We often treat or re-treat areas that have gone through prior chemotherapy, radiation or surgery. I brought stereotactic radiosurgery of the body to the Western hemisphere and I believe have the largest experience worldwide.

Thus, from head to toe stereotactic radiation and radiosurgery are available options for patients.

Question: ***Why is radiation so well received by patients?***

Dr. Lederman: For the patients, radiation is highly effective in curing cancer, preventing the recurrence of cancer, or relieving symptoms of cancer. It is directed localized therapy avoiding much of systemic treatment's toxicity. Because radiation is generally administered by external means, it avoids the invasiveness of surgery. In specific diseases such as prostate cancer, implant therapy is producing early results highly suggestive of benefit compared to radical prostatectomy or standard radiation.

Twenty years ago, for example, mastectomy was the most popular method used for treatment of breast cancer. Today, more and more women with breast cancer are diagnosed early. More women than ever before are choosing lumpectomy (removal of the lump of cancer in the breast) followed by radiation. These products a result that is equivalent to mastectomy but avoids the psychological, cosmetic and physical effects associated with mastectomy. Multiple randomized studies have confirmed the efficacy of this approach.

Radiation is generally well received by patients because, in essence, it is non-invasive treatment and localized treatment with more precise technology such as brachytherapy and stereotactic radiosurgery. Treatment is more direct and, in general, safer than ever before. We can minimize the amount of healthy tissue affected and maximize dose to the cancer.

From benign to cancerous tumors we have a fairly large track record.

Question: ***In the 1970s, cobalt was the most popular form of radiation. That is no longer true today?***

Dr. Lederman: In recent years, high energy linear accelerators have been able to successfully place the radiation dose deep in the body, minimizing normal tissue irradiation. This technology helps to achieve an appropriate distribution of radiation to the target while minimizing adverse effects. There is still a role for cobalt as it remains an important option (among many) for the radiation oncologist.

Question: ***What are the main differences between cobalt and linear accelerator-derived radiation?***

Dr. Lederman: Cobalt is a radiation source that constantly emits radiation. Shielding within a cobalt machine allows sale use of' this type of radiation for medical purposes.

Early linear accelerators were built to mimic the cobalt machine's energy range. A four million volt (MV) linear accelerator gives a distribution of radiation very similar to cobalt. The point of maximum intensity of radiation (D-max) with cobalt using a single field aimed at the body is one-half centimeter deep from the surface. This compares to a 4 MV linear accelerator producing a beam that has a D-max of 1 cm. The linear accelerator produces more skin sparing and thus so-called radiation dermatitis is less commonly associated with this type of machine. Treatment planning is crucial in producing the best results of therapy.

Of course, now there are many different energy linear accelerators. We are fortunate to be in a modern hospital with true-state-of-the-art linear accelerators producing beams up to 18 million volts. These have a much deeper D-max.

New additions to machines and new machines increase intensity modulation, which modifies the radiation to give more precise shaped beams to attack tumors, and help avoid healthy normal tissues. Imaging and gating to turn on and off the machine as well as stereotactic frames to help minimize respiration ad to help guide beams of radiation are certainly used on a regular basis.

Question: ***That is an exceptionally powerful beam. For what purposes is it used?***

Dr. Lederman: High energy beams from the Varian 2100C Linear Accelerator are used to place radiation deep in the body. For those with pelvic malignancies like prostate cancer or gynecologic malignancies such as cervix cancer and endometrial cancer, it is commonly utilized. For lung cancer treatment, it deposits the radiation deep within the lung, minimizing the effect on skin and superficial tissues.

Question: ***Aren't linear accelerators commonly used for women with breast cancer?***

Dr. Lederman: Yes. Linear accelerators minimize the skin dose while effectively offering radiation to the entire breast. We know that linear accelerators produce the best cosmetic outcome for women choosing lumpectomy/radiation instead of mastectomy. It is for this reason that a linear accelerator (commonly nicknamed "Linac") is used.

Question: You are describing the photon capability of linear accelerators. Do your Linacs have another mode as well?

Dr. Lederman: That is correct. In fact, we have numerous other modes producing a variety of electrons. Electrons used for medical purposes have a more limited degree of penetration and, therefore: are important in treatment of more superficial malignancies. Deep tissues can be spared the radiation effects when electrons are implemented.

Question: ***What energies and of what use are electrons?***

Dr. Lederman: Our Varian 2100C Linear Accelerator has multiple electron energies including 4, 6, 9, 12 and 16 MeV (millions of electron volts). Common uses of electrons are to boost the radiation dose for women choosing lumpectomy/radiation and to treat skin cancers that are either unresectable or where surgery would leave an undesirable cosmetic effect. There are many other uses for electrons including radiation around the neck to prevent damage to the spinal cord.

Question: ***Who operates the linear accelerators?***

Dr. Lederman: Operation of the linear accelerator is highly complex. In our institution we have three radiation oncology physicians, three medical physicists, three dosimetrists, block cutters, radiation engineers, and an entire staff of radiation therapists.

Question: ***Who does what?***

Dr. Lederman: The physician specialist - a radiation oncologist -- oversees the entire patient treatment. He or she directs physicists, dosimetrists and radiation therapists, as well as radiation nurses. It is the radiation physicists and dosimetrists who translate the physician's prescription so that proper fields and doses of radiation are administered. The radiation physicists, along with engineers, maintain the equipment in tip-top condition. There are routine and daily quality assurance checks performed.

Question: ***What is the rule of the radiation therapist?***

Dr. Lederman: Radiation therapists actually deliver the radiation on a daily basis. They work under the direction and guidance of the physician. Their training often includes extensive college education as well as two mandatory years of training in radiation by New York State law leading to licensure and registration. Vigorous examination is required prior to radiation therapists receiving their registry.

Question: ***With what equipment does the radiation physicist and dosimetrist work to achieve the desired goal for each patient?***

Dr. Lederman: There are sophisticated computers in our department, for example, that allow the physician, physicist and dosimetrist to determine the best distribution of radiation. The different energies of photon and electron beams are used differently in each patient depending on the area being treated and the size and girth of the patient. Different size radiation fields create different beam characteristics which must be taken into account prior to therapy.

Question: ***I understand that you have a great variety of computer planning systems in your department?***

Dr. Lederman: That is true. We have specific computer planning systems for radiosurgery, brachytherapy and external-beam radiation therapy. Sophisticated computer technology available now allows us to do highly complex treatments that weren't thought of years ago and in fact aren't available in many centers around the world. I believe it is that reason that propels people to seek treatment with us. It also ahs to do with our vast experience as well as our vision. Patients must share the doctor's vision otherwise there is a schism. We believe in excellent patient care and delivery precise effective radiation trying to minimize harm when possible to healthy normal tissues.

Question: ***Can you describe the differences in each of these therapies?***

Dr. Lederman: External beam radiation therapy is the so-called standard radiation. The beam comes from outside the patient to attack the target. The target may either be a malignancy or an area where there is a high rate of cancer recurrence. When radiation is used to prevent the recurrence of a resected or removed cancer, it is known as adjuvant therapy. Radiation used to cure cancer is called radical therapy. The last instance of radiation use is palliative therapy - to relieve symptoms.

Question: ***Would you briefly describe stereotactic radiosurgery?***

Dr. Lederman: Stereotactic radiosurgery is pinpoint precision radiation. It is used to treat lesions in specific areas of the body. The area in which we have tremendous expertise includes treatment in and around the brain. In that instance, a head frame and high resolution CT scanning are used to help localize the malignancy. Radiosurgery sends beams from thousands of angles to attack the tumor while minimizing radiation to the surrounding structures.

We were one of the first groups worldwide to sue fractionated stereotactic radiosurgery for the brain. We did that because the head frame was non-invasive and doctors have known for decades that fractionation decreases the harmful effects to the healthy tissues. For example, we treat acoustic neuromas with the lowest biologic dose and fractionate which likely leads to better hearing. We have the largest experience worldwide. Fractionation has shown in glioblastomas to result in higher survival rates compared to single fraction radiosurgery. For brain tumors, single fraction usually means pins deep into the skull while our treatment is totally non-invasive.

Similarly, our group pioneered extracranial or body radiosurgery in the Western hemisphere. We brought this technology to the United States and have the largest experience worldwide. Body radiosurgery allows us to precisely treat tumors most anywhere in the body. Commonly treated tumors are primary and lung cancers, mediastinal cancers; cancers of the liver, pancreas, spleen, kidney, adrenal glands and cancers of gynecologic and urologic organs. We use stereotactic radiosurgery for prostate cancer. Both primary and metastatic caners are treated and the control rate – meaning cessation of growth, shrinkage or disappearance of the cancer in the treated field – is very high. Unlike chemotherapy, in general, the results are very durable in the treated field. We have specific information available concerning this technology – on the website, in pamphlet as well as video form.

Question: ***Can you describe brachytherapy?***

Dr. Lederman: Brachytherapy is radiation that is placed within the body. Brachy means "that at short distance." thus brachytherapy is radiation delivered at close proximity to a tumor. Examples include endobronchial implantation for primary or recurrent lung cancers. Most lung cancers begin in the airways and often can cause obstruction of the airways. Obstruction can lead to bleeding, shortness of breath or even post-obstructive pneumonia - an infection behind the obstructing tumor. New methods most commonly treat these conditions effectively and quickly.

Brachytherapy can also be used in other sites like the esophagus for esophageal cancers, and is commonly used for gynecologic malignancies such as cervix and endometrial cancer.

Question: ***Those are uses of temporary brachytherapy. Are there additional instances where you permanently place radiation seeds in the body?***

Dr. Lederman: We have an active program for men with localized prostate cancer using iodine and palladium seeds as well as external-beam radiation therapy. We obtain a high degree of local control. Current data shows the effectiveness of brachytherapy or seed implantation for prostate cancer. Actually, data reveals superiority over external-beam radiation therapy or radical prostatectomy for men with localized prostate cancer.

Question: ***What is the role of "block cutting" in radiation?***

Dr. Lederman: Block cutting allows a radiation physician and physicists to shape the external beam radiation field specifically for patient care. It modifies the radiation beam that comes out of the linear accelerator and cobalt machine to accurately reflect the target to be treated - again minimizing normal tissue irradiation.

While blocks were an important way to shape the beams, in many ways, radiation has moved beyond that using multileaf collimation. Multileaf collimation is actually within the linear accelerator itself and shapes the beams. These fine mechanical leafs and can be electronically moved to precisely shaped beams in a treatment called intensity modulated radiation therapy or IMPRT. Thus, while blocks certainly are available, in many ways they have been superceded by newer technology.

Question: ***How long is a typical radiation treatment?***

Dr. Lederman: There are many kinds of radiation. For the patient receiving external beam radiation therapy a treatment may last only ten minutes with the patient coming in, getting the treatment and returning to home or usual activities such as work. Skin marking and lasers help the therapists accurately reproduce the treatment field. The duration of actual exposure to the radiation beam usually lasts a minute or two. For those undergoing implantation, a longer stay is required. Radiation seed implantation usually requires about 90 minutes in the operating room under local anesthesia. A stereotactic radiosurgery treatment may range from 30 to 60 minutes, depending on the complexity.

Question: ***And a typical course of radiation?***

Dr. Lederman: Again, a course may vary greatly. For the woman receiving post- lumpectomy radiation, the usual course is about 33 treatments or 6-1/2 weeks on a five- day-a-week schedule. Treatments usually take only a few minutes and can be administered anywhere from early morning to late afternoon. We do everything possible to accommodate patients' schedules and respect religious observances. Some treatment courses are as short as a single treatment.

Each treatment is different and it is best for a patient to speak to physicians about treatments. While some are short, some are longer and this depends on the size, shape, dose and treatment set-up complexity.

Question: ***How long is the process between the planning of radiation and actual implementation of radiation?***

Dr. Lederman: That depends. In emergency situations, radiation is implemented immediately. Simulation of the radiation, calculation of the radiation dose and delivery by our staff takes place on a 24-hour-a-day, seven-day-a-week basis. Usually, radiation treatment commences several days after radiation simulation. Complexity makes an important difference here. Some treatments are very, very complex and require days to plan. Other treatments are done within a day. Again, we try to use our best judgment and expertise for ach patient to speed delivery but not cut corners.

Question: ***What is radiation simulation?***

Dr. Lederman: Radiation simulation is the procedure when the patient's radiation is actually planned. Simulation simply implies that the treatments are technically planned, x-rays are taken,

fields are marked out and measurements are made to permit all information to be computerized for appropriate delivery of the radiation.

Question: ***Are tattoos routinely used in your department?***

Dr. Lederman: Yes. Small, permanent marks are most commonly made on the patient's skin when external beam radiation therapy is used. This allows accuracy of treatment set up and future knowledge of where prior radiation was given. There are patients who will require subsequent radiation. More accurate knowledge of prior treatment allows the best possible outcome in this situation.

In certain cases, tattoos are not used. For example, in stereotactic brain radiosurgery a very precise head frame system obviates the need for tattoos. Some patients refuse tattoos and we use other types of markers. Often tattoos, however are still used along with other methods of localizing tumors for the best quality assurance.

Question: ***What areas are of greatest expertise with your group?***

Dr. Lederman: We have a variety of expertise including benign and malignant tumors of the brain using fractionated stereotactic radiosurgery; primary and recurrent cancers of the body using fractionated body radiosurgery and brachytherapy for prostate cancer, often combined with fractionated body radiosurgery.

Our group pioneered the use of stereotactic body radiosurgery in the Western hemisphere. We have amongst the largest experience – if not the largest experience worldwide. We track our patients so we diligently evaluate our data on a regular basis. Our information is reported at national and international meetings. Patient seminars are scheduled on a monthly basis so that each person can learn more about treatments in an informal environment.

With thousands of patients treated, there can be much reassurance about the expertise in our hands.

Question: ***What information is available to patients?***

Dr. Lederman: We have packages of information concerning the brain, body and prostate cancers. This is available by calling us at 212-CHOICES. We have monthly seminars in an information environment allowing prospective patients to hear about current information and ask doctors questions in a situation that is different than a consultation. Obviously, consultations are also available.

Question: ***How can one learn more about whether new treatment options are right for them?***

Dr. Lederman: We have a panel of experts to evaluate patients. We ask for current scans, reports and a brief medical history. These meetings take place several times a week and so an answer to your clinical questions should be readily available. Also, our physicians are happy to speak to you. You can either correspond via e-mail to gil.lederman@rsny.org or call us at 212-CHOICES.

Question: ***Are you involved in academic activities?***

Dr. Lederman: I've published many papers in my career and in the past 12 months I have presented and/or published many reports. Our reports on stereotactic radiosurgery for treatment

of acoustic neuromas as well as body radiosurgery were accepted and delivered at the recent American Society for Therapeutic Radiation Oncology' annual meeting.

I believe patient education is important. We encourage our patients to become informed about current data for their needs. Regular articles are published outlining scientific and medical advances. These are distributed to patients.

Question: ***Are examples of your work and tours available?***

Dr. Lederman: Certainly. I encourage those interested in radiation to view outcome results

Question: ***What are the major issues facing radiation oncology today for physicians, staff and patients?***

Dr. Lederman: Radiation has greatly evolved over the years. Stereotactic radiosurgery, in fractionated form, is now available for the brain and body. It allows patients with benign and malignant tumors of the brain to consider non-invasive options that are highly focused and accurate, with high control rates. For example, our current data for meningiomas in patients who have not had surgery has a 99% control rate. The same 99% control rate is true for acoustic neuromas as well. Control rate is defined as cessation of growth, shrinkage or disappearance of the tumor in the treated field.

For cancers of the body where we aim our radiosurgery beam, our control rates are about 80-to-90%. By focusing radiation using higher dose per fraction, we get over the biological slope at the curve, making radiation more effective. All this requires a team of experts including physicians, physicists, dosimetrists, techs and others.

We encourage those with questions to contact us at 212-CHOICES or e-mail questions to gil.lederman@rsny.org. Radiation is improving rapidly as is data and options. We have free seminars open to the public to discuss new advances in treatment of brain, body and prostate cancers.