CHAPTER TEN
3D Conformal Radiation

Drs. Gerald Hanks, Loren Buhle, Jeff Michalski, Scott Press, and Aubrey Pilgrim

X-rays are like a sharp knife that can reach inside the body and operate on a tumor without doing much damage to the surrounding tissues. It is usually much less traumatic and invasive than scalpel surgery. If this is so, why doesn't every one choose x-ray therapy? At one time persons treated by x-ray therapy had more recurrences of cancer and also had a shorter life expectancy. X-ray technology and procedures have improved and most data now shows that there is very little, if any, differences in radical surgery and 3D conformal radiation therapy (3DCRT). Fig. 10-1 shows a 3D Conformal External Radiation machine.

Someone on the internet asked about skin damage during radiation. Dr. Loren Buhle, answered this way:
"When a linear accelerator is used to deliver radiation, the radiation beam has sufficient energy to begin depositing energy several centimeters below the skin surface. This distance between the skin surface and the depth where the x-ray beam starts depositing energy is called the "depth dose". This can be calculated during treatment planning.

Some men have erectile dysfunction or become impotent after the prostate is removed because the nerves and blood vessels that control erections are damaged or severed. These nerves and blood vessels may also be damaged by x-rays but may not be immediately evident. Certain tissues, such as the cells of blood vessels, which often divide and replace other cells, are more susceptible to x-rays than others.

The rate of impotence may be fairly low immediately following radiation. But over a period of time, the damage done to the blood vessels and nerves, the person may gradually lose his potency. He may also develop incontinence problems at some later date after radiation.

One disadvantage of x-rays is that it may not kill all of the cancer cells. Another disadvantage of radiation is that one can never be certain of the true pathological stage of the cancer. The clinical staging from biopsies, PSA and DRE is very often understaged. The only way to get a true pathological stage is after the prostate is removed.

How Radiation Kills Cancer Cells

High dose radiation damages the DNA and chromosomes in the nucleus of cells. Unless the dose is very high, normal cells are usually able to recover. But cancer cells are less able to recover from radiation damage. They lose their ability to divide and multiply and eventually they die. All cells are more vulnerable to radiation during the process of dividing. Cancer cells usually divide more often than most normal cells so the radiation can kill more of them.

Cells that don't usually divide, such as the brain cells, are relatively immune to radiation. (Incidentally, we have several billion brain cells. Though not very sensitive to radiation, they are sensitive to certain chemicals such as alcohol. A few cells are killed every time we indulge. Other chemicals and drugs that we come in contact with also kills them off. As we get older, we become more absent minded and forgetful as more of our brain cells are killed off. But we shouldn't worry about it too much. As a percentage of the total several billion, the few million or so that are killed off in a lifetime are a very small amount of our total. So go ahead and have a couple glasses of red wine. Enjoy. If you find yourself forgetting, just forget it.)

It is a paradox that a small dose of radiation to normal cells may cause them to become cancerous. It may not be enough to kill the cell, but it may damage some of the chromosomes and cause cancerous mutations. Dr. Malcolm Bagshaw, of Stanford, was one of the early pioneers in radiation. At one of his presentations he said that most healthy cells are able to repair any damage received during radiation. But some of the damaged cells may eventually become cancerous. However, it may take several years for any such cancer to become significant. If the primary cancer is controlled, the patient may die of some other disorder before any x-ray caused cancer would become a problem.

Some studies have indicated that neoadjuvant hormone therapy, that is, hormone therapy before radiation, may sensitize cancer cells so that radiation is more effective in killing them. Studies have also shown that adjuvant hormone therapy after radiation adds a survival advantage.

Maximum Dosage

One disadvantage of radiation is that a person can only be exposed to about 6000 to 8000 rads maximum in a life time. If the cancer recurs, then some other method of treatment such as hormone therapy, salvage cryosurgery or a radical prostatectomy must be chosen.

If a person is to have 7000 rads (70 Gy) or more of x-ray therapy, it must be given over a period of time. The treatment is usually given five days a week. The usual treatment dose is two Gy per day. If a person is given 4 to 6 Gy at one time, it could be fatal, so the dose must be carefully controlled. If a person is given 2 Gy a day, their body can recover to some degree before the next treatment.

Radiation Terms and Acronyms

Incidentally, there are some rather confusing terms and acronyms having to do with radiation. The term rad is an acronym meaning radiation absorbed dose. The term rem is an acronym for roentgen equivalent man. The rem is the absorbed dose of radiation that produces the same biological effect as 1 rad. The rem, the rad and the roentgen are all virtually the same. An example of a rem, for a routine chest x-ray, a person is exposed to about .1 to .2 rems. One hundred rads is equal to one gray (Gy). One gray is also equal to the same equivalent dose of ionizing radiation of 1 sievert (Sv). Another acronym is RBE which means relative biological effectiveness. The RBE is usually reserved for comparisons of heavy particle radiation. For instance, protons may have a RBE of 1, but neutrons may cause more damage and have a RBE of as much as 3. Normally, X-rays may have a RBE of less than 1.

A problem with earlier x-ray treatments for prostate cancer was that often the rectum and bladder were overexposed and severely damaged. Damage such as this usually required bladder and rectal surgery. After rectal or bladder surgery, the patient usually had to wear a colostomy bag to collect urine or feces. The procedures and technology have greatly improved and today there are very few cases where unwanted tissues are damaged during radiation.

One way they prevent damage to other tissues is by using shields and accurately directing the beams. They may also focus the beams over the left hip for a short time, then straight above the pelvic area, then from the right hip. The beams all intersect and focus on the prostate area, but since only a small amount of time is spent going through the hips and the bladder in front, little or no damage is done. Some systems use an x-ray machine that continuously moves from side to side to accomplish the same objective.

Most types of radiation are part of the electromagnetic spectrum that includes radio waves, infrared radiation, visible light, ultraviolet light, gamma rays and x-rays. There are two primary categories of radiation, ionizing and nonionizing. There are several different types of radiation for each of these categories. If you remember your high school science, all atoms have electrons in orbit around the nucleus. Ionizing means that the radiated beams are strong enough to forcibly dislodge electrons from their orbits. Once an atom loses an electron, it becomes ionized and now has an electric charge. Nonionizing radiation are things such as visible light, ultra violet light, electromagnetic radio waves, microwaves, lasers and ultrasound. Nonionizing radiation may cause excitation of the atoms in molecules, but is not strong enough to dislodge electrons. Microwaves work by exciting and agitating the atoms in molecules which causes heat to be generated.

We are primarily interested in the ionizing type of radiation for prostate treatments, although there are several treatments that utilize lasers, microwaves and high frequency radio waves. There are three main types of ionizing radiation, x-rays, gamma rays and particle radiation. X-rays are generated artificially by special high voltage electrical machines. X-rays have no mass or weight or electrical charge. They have a very high frequency and a very short wavelength. Their penetrating power depends on the amount of energy or voltage used to create them. It requires about 100,000 volts to force x-ray beams to pass through a body for a normal x-ray image. For radiation therapy, it may require several million volts. With enough energy behind them x-ray beams can even penetrate steel.

Gamma rays are very similar to x-rays except that they are produced by the spontaneous decay of radioactive materials such as uranium, plutonium, radium and certain radioactive isotopes. The radioactive materials activity is measured by their half-life. Plutonium has a half-life of 76 million years. At the end of 76 million years, exactly half of the plutonium's radioactivity would have been used up. Radium has a half-life of 1,622 years. There are several materials that can be made artificially radioactive due to bombardment with high energy particles. Palladium 103, used as seeds in brachytherapy, is an artificially produced radioactive isotope that has a half-life of 17 days.

There are several other artificially produced elements that have a half-life of only seconds or even microseconds. (Incidentally, as the radioactive materials decay, they lose weight and eventually become a different and lighter element. After several million years, uranium goes through several transformations into lesser atomic weight elements, including radium. After it loses all of its radioactivity uranium becomes common lead.) There have been some tremendous advances in X-ray technology and treatments in the last few years.

The article below was written by Dr. Gerald Hanks, one of the country's foremost practitioners of 3DCRT.

Three Dimensional Conformal External Beam Treatment
Of Prostate Cancer

Gerald E. Hanks, M.D.
Chairman, Department of Radiation Oncology, Fox Chase Cancer Center

Introduction

Conformal three dimensional external beam treatment (3DCRT) of prostate cancer was introduced in the United States between 1987 and 1989 at the University of Michigan, Memorial Sloan Kettering Cancer Center and Fox Chase Cancer Center. Two of these three institutions then joined with 7 others (Univ. of California-San Francisco, Univ. of Chicago, Univ. of Miami, Univ. of North Carolina, Univ. of Washington, Univ. of Wisconsin, and Washington University) in 1992 and began a prospective clinical trial group studying the effects of increased radiation dose in prostate cancer with 3DCRT. All of these institutions named above are considered as having substantial long term experience with 3DCRT.

The goal of 3DCRT is to "hit" all of the target (prostate) each day of treatment while hitting a minimum of surrounding normal tissue. Three steps are involved in assuring this level of accuracy:

(A) The patient is immobilized in an individual cast that assures that he is in the same position for his treatment planning and for each single treatment. The cast has been shown to reduce day-to-day variation in exactness of positioning for treatment by about 1 centimeter (cm). (Note: In case you don't remember your high school metric conversions, 1 cm is approximately 3/8 of an inch). The prostate, with or without seminal vesicles, can be included within a shell of normal tissue around the gland 1 cm thick. If immobilization is not used the shell of normal tissue around the gland would need to be 2 cm thick.

(B) A CT scan is performed with the patient in his cast and the prostate gland is identified in three dimensions.

(C) The treatment beams may be directed at the prostate from 4 to 6 directions. Each beam is specifically shaped so that it conforms to the shape of the target as seen from any particular beam direction. Conformal therapy is thus conforming the beam to the shape and size of the target while including a 1 cm margin of normal tissue for safety purposes.

The apex or bottom of the prostate gland is difficult to identify on a CT scan unless a urethrogram is performed. The urethrogram fills the penile urethra with dye up to the muscular urogenital diaphragm. The apex of the prostate has a fixed relationship to the urogenital diaphragm and that margin of the gland can be accurately included in conformal fields when this urethrogram technique is utilized.

What are the benefits of 3DCRT in reducing normal tissue injury?
Acute symptoms are those appearing during the course of radiation treatment and are markedly reduced by 3DCRT. Symptoms of bowel and bladder irritation that require medication were reduced from 57% to 36% of patients comparing 3DCRT patients to those treated with conventional treatment methods.

Late serious complications are dramatically reduced by 3DCRT and very few serious complications are observed even at doses that simply cannot be delivered with conventional treatment technology. Thus, patients can be treated to higher doses with an improved chance of curing their cancer while experiencing complications that are far below the USA national averages. When we compare the serious late complications of 3DCRT to previous reports of conventional radiation, 3DCRT has complications rates of less than 1% or 2% while conventional radiation may have a range from 5% to 10%.

Previous studies have demonstrated that patients with pretreatment PSA’s higher than 10 ng/ml need radiation doses that are higher than commonly used to obtain optimal control of their cancers. A great deal of clinical research has been conducted by several of the institutions named above which indicates that 75 Gy improves the chances of controlling prostate cancer significantly more than the 65 Gy-70 Gy commonly used with conventional treatment.

What is the success of 3DCRT curing prostate cancer?
Our studies and those of the University of Michigan, Memorial Sloan Kettering Cancer Center and the University of California-San Francisco show 10 year results that are equal or better than those reported from prominent surgical series in patients with early disease (T1, T2A, B, Gleason 6 or less, PSA <10 ng/ml). Eighty-five percent of these patients will have no signs of cancer at 10 years. The results of 3DCRT in locally advanced cancers with higher PSA's stand alone as surgery is not generally performed in patients with bulky disease. Forty to 70% of these patients will have no signs of cancer at 10 years depending on pretreatment PSA characteristics.

At Fox Chase when we compared our 10 year results with 3DCRT to those previously obtained with conventional radiation therapy we noted an overall 10% improvement in biochemical freedom from cancer at 10 years.

Is surgery preferable for younger men?
We have recently examined our results in younger men because of the existing prejudice that surgery produces improved results in this group of patients. We found no such evidence as our men under 65 with pretreatment PSA's <10 ng/ml experience 80% biochemical freedom from disease at 10 years. This value is equal to treatment reports with surgery. In addition, we examined the maintenance of sexual potency in these young men. At 2.5-3 years after treatment 73% of them maintained their potency. This, again, is an excellent result that is superior to many surgical reports.

Thus, we feel that young men have a treatment option between conformal radiation therapy and radical prostatectomy and should be allowed to consider either of the two treatment options.

Our first 10-year results are available on favorable T2A patients with PSA <10 ng/ml, 80% are free of cancer at 10 years and are cured. Patients who survive 5 years without a rise in their PSA are also cured as we see only 2% of our total failures between 5 and 10 years.

ASTRO
The American Society for Therapeutic Radiology and Oncology (ASTRO) is the largest radiation oncology society in the world, with more than 5,000 members. As a leading organization in radiation oncology, biology and physics, the society's goals are to advance the scientific base of radiation therapy and to extend the benefits of radiation therapy to those with cancer.

Here is an abstract from a presentation made at the 1999 meeting of the American Society of Therapeutic Radiation Oncologists (ASTRO):

INTERMEDIATE OUTCOMES FOR 3D-CRT IN YOUNG MEN WITH NON-PALPABLE OR UNILOBAR PROSTATE CANCER AND PSA < 20 NG/ML

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Purpose:
Young men with localized prostate cancer are more commonly treated with radical prostatectomy than radiotherapy. We report intermediate outcomes for young men treated with 3D conformal radiotherapy to see if this bias in treatment is supported by outcomes.

Methods:
Between 10/89 and 10/96, 96 men age 65 or younger with clinically staged T1-T2A (1997 AJCC), Gleason Score 2-6 without perineural invasion, pre-treatment PSA < 20 ng/ml adenocarcinoma of the prostate with a minimum follow-up of 2 years were treated at Fox Chase Cancer Center. All patients were treated with definitive 3D conformal external beam radiotherapy alone. The median follow-up was 46 months (24-101 mos). The median patient age was 61years (51-65 yrs), and the median treatment dose was 7278 Gy (6780-7972 Gy).

Patients were stratified into groups depending on clinical stage (T1 vs. T2) and pre-treatment PSA (0-9.9 vs. 10-19.9 ng/ml). Estimates of rates for biochemical No Evidence of Disease (bNED) control and morbidity were calculated using the Kaplan-Meier product limit method. Biochemical failure was defined according to the ASTRO consensus definition and time was measured from the start of treatment. Genitourinary (GU) and gastrointestinal (GI) toxicity were assessed using the RTOG criteria.

Results:
Overall 5-year bNED control for all patients was 85%. The results appear durable, as no failure was noted after 40 months of follow-up. Grade 2 GU morbidity at 5 years was 5%, and no grade 3 GU morbidity was observed. Grade 2 GI morbidity at 5 years was 16%, and grade 3 GI morbidity at 5 years was 1%.

Conclusion:
Outcomes using 3D conformal external beam radiotherapy for the treatment of adenocarcinoma of the prostate in young patients who would be considered candidates for surgery or brachytherapy (clinical stage T1-T2, Gleason score 2-6, pre-treatment PSA 0-19.9 ng/ml) are excellent, suggesting that a treatment method bias based on age is not justified. Long-term morbidity is minimal, less than that documented in the majority of surgical series and equivalent to or better than those reported in most brachytherapy series.

Based on our results, young men have a choice of treatment for their early prostate cancer and should consider 3D-CRT.

SUMMARY

Three dimensional conformal radiation therapy is probably the most important technological advance in radiation oncology over the decade of the nineties. I believe that the reduction in serious side effects and the improvement in prostate cancer cure rates is of great importance. Men who are candidates for curative treatment now can consider the improved benefit associated with 3DCRT.

Internet Questions Concerning 3DCRT

Dr. Loren Buhle and Dr. Jeff Michalski are both experts on 3DCRT. They both spend a lot of time on the internet answering questions.
Below are a couple of questions and answers:

Mr. P.S. wrote:
"I am about to start high beam 3DCRT and have just yesterday completed the planning/simulation session wherein I was marked up, tatooed, x-rayed, and had a cat scan to verify the marking locations. My concern is that I have read in Dr. Michalski's home page that in most cases some sort of immobilization device is used to assure radiation pointing accuracy (I presume). In the trauma of the moment yesterday, I was too caught up to think to ask the following:
How do the medical workers (doctor, dosemetrist, whoever) assure that the radiation is going to be positioned in the place that they would like?"

Answer by Dr. Buhle:
There are laser alignment aids in the room (look along the walls, you'll see them). This gets the patient's body in the right place. Then there may be immobilization casts to get the body in the right position. Of course, if you tense your buttocks, the bladder/prostate move...though your body is in the same position. During the delivery of the radiation...a film is sometimes taken (this is called a portal image). In one or two places, a camera is used instead of film and a movie is taken during treatment (this is a research setting only). The purpose of this portal view is to compare with the simulation films. Remember...the target consists of a boundary of normal tissue at risk...so if there is a bit of motion, say a few millimeters, it won't matter anyway.

The CT scan was to collect contiguous image sections to generate a three dimensional model of your body (organs, tumor and surrounding normal tissue at risk). Depending on the treatment planning session...this model is used to visualize the radiation portals and (might be) used to calculate the radiation treatment (dose deposition). I wrote code while at Penn to take into account the heterogeneity of the tissue in the beam path...since the energy deposition differs when the beam goes through airspace, liquid, bone, and soft tissue. Is this important in the outcome? I'd like to say yes...but I really don't know (probably more important where there is a lot of heterogeneity...such as treating lung tumors).

Very likely they will use the tattoos for lining your body up with the lasers in the room...and the rest of the positioning will be confirmed with films taken during the treatments.

"Generally, how many workers (one?) are involved in the actual treatment process on a day to day basis, for a forty-treatment series extending over eight weeks?"
There is the physician, the planning personnel (dosimetrist, medical physicist), technicians delivering the treatment, and the nurses.

Here is Dr. Jeff Michalski's answer:
In 3DCRT the CAT scan is the critical first element for tumor localization and plan development. It would not be used to "verify" markings. Markings should be determined "FROM" the CAT data. In 3D planning methods the CAT scan serves as the initial planning simulation session. We may use a "verification simulation" after the planning to verify markings. This is done in a conventional therapy simulator.

Dr. Loren answered your question about positioning but I think it is worth restating that modern day linacs are checked for accuracy to within 2mm and a series of laser alignment devices in the room assist in the patient set up. Therapy portal radiographs (port films or port images) are compared to the original prescription image (simulation film or digital reconstructed radiograph from the 3D planning system) to assure accurate setup. Standard procedure is to check these weekly.

On our 3D dose escalation trial we check them twice weekly for the first week or two. In addition, in creating the RT plan, the physician should have allowed for some variation in the position of the target. The margin for uncertainty accounts for small setup errors and internal organ motion.

The immobilization device we use is a foam cradle ("alpha cradle"tm). Some investigators have shown the use of a device like this minimizes the variability of treatment setup. Other institutions use thermally sensitive plastic devices. These soften when warmed and firm up as they cool. They are heated then molded to the patients' contour.

As to the number of workers in the room, there are always at least two radiotherapists (RTT) involved in the setup procedure. On many of our 3DCRT patients, we use 3 RTT's. During the course of 8 weeks we try to keep the same team together but invariably there will be some "cross coverage" or team rotation to keep each RTT familiar with the setup and procedure for the 3DCRT patients.

JEFF M. MICHALSKI, M.D. Radiation Oncology Center, Mallinckrodt Institute of Radiology, Washington University, St. Louis, MO.

Nocturia

Here is a question on the internet about a 3DCRT complication:

Three months into CHB and 3 weeks into 3DCRT. Most difficult side effect is nocturia. About every 2 hours after going to bed. During day I am totally normal. Tried several prescriptions, nothing helps. Now for the wild idea. What if I took a diuretic during the day to produce an empty bladder by bedtime? If bladder is empty would that reduce the need to urinate every 2 hours during sleep time? Appreciate any comments by anybody. H.G.

Answer by Dr. Scott Press:
The nocturia that you are feeling is related to the radiation therapy not the presence of large amounts of urine in your bladder. Since RT causes inflammation in the trigone (base) portion of the bladder and the prostatic urethra as a natural side effect, the nerves there are very sensitive. The slightest amount of urine will cause you to feel that you have to urinate i.e. 50 cc. At night a buildup of a small amount of urine makes it feel like you have to go. The treatments for this condition, known as "urgency", are not totally effective.

I can tell you one that will not work and that is to take a diuretic during the day. This will only increase the symptoms by causing large amounts of urine to be produced at a time. Therapy revolves around the etiology of the symptoms.
If the urgency is caused primarily by the prostate, try Hytrin 5 mg every night or Cardura 4 mg every night. These drugs are known as alpha-1 blockers and inhibit the nerves causing symptoms in the prostate. If the urgency is primarily bladder in origin: Ditropan 5 mg at night time will calm the bladder muscle and nerves down so that the feeling of urgency will be less.

Anti inflammatory meds like Naprosyn, Aleve, or Advil will help also but carry a risk of bleeding since they inhibit platelet aggregation.
Hope this helps.

Scott M. Press, M.D. Department of Urology, The Long Island Jewish Medical Center, New Hyde Park, New York 11040

Radiation Plus Hormone Suppression

Dr. Gerald Hanks has also done some studies combining hormone suppression therapy with radiation- He reported the results of a study at the American Society of Clinical Oncologists (ASCO) 2000 meeting. Here is a copy of his abstract #1284:

RTOG Protocol 92-02: A Phase III Trial of the Use of Long Term Androgen

Suppression Following Neoadjuvant Hormonal Cytoreduction and Radiotherapy in Locally Advanced Carcinoma of the Prostate. Gerald E. Hanks, Jiandong Lu,
Mitchell Machtay, Varagur Venkatesan, Wayne Pinover, Roger Byhardt, Seth A Rosenthal, Fox Chase Cancer Ctr, Philadelphia, PA; American Coll of Radiology, Philadelphia, PA; Univ of Pennsylvania, Philadelphia, PA; Univ of Western Ontario, London, Canada; Medical Coll of Wisconsin, Milwaukee, WI; Sutter Cancer Ctr, Sacramento, CA.

RTOG Protocol 92-02 was a prospective randomized trial of androgen suppression and external beam radiation in patients with locally advanced prostate cancer (T2C-T4) with PSAs less than 150 ng/ml. All patients received Zoladex and Flutamide two months before and two months during radiation and were randomized to no further therapy or 24 months of additional Zoladex alone. Of 1554 patients entered, 34 were found to be ineligible. The median follow-up is 4.8 years. The two arms were well matched on stratification and other variables.

The group with long-term androgen deprivation (LTAD) showed significant improvement in disease-free survival 54% vs 34% (p = .0001), local progression 6% vs 13% (p = .0001), distant metastasis 11% vs 17% (p = .001) and biochemical failure 21% vs 46% (p = .0001). Fifty-four patients died of prostate cancer in the short-term androgen deprivation group (STAD) compared to 33 in the LTAD. Disease specific survival (DSS) showed a trend in favor of the LTAD group 92% vs 87% (p = .07). Five-year survival was not different between the two arms (78% vs 79%). There was a significant increase in RTOG grade 3 and 4 bowel complications in the LTAD group, 42 vs 26 (p = .04).

Two other subsets were analyzed; one comparable to those entered in Bolla et al, NEJM 1998. This subset (T3, T4 and T2 with Gleason 8-10) showed no survival difference (77% vs 79%) at 5 years but a significant advantage in DSS for LTAD 90% vs 86% (p = .03). The second subset, including all Gleason 8-10, is compared to a previous subset analysis of RTOG 85-31 (Pilepich, JCO, 1997).

Five-year survival was significantly better with LTAD 80% vs 69% (p = .02). DSS was significantly better with LTAD 90% vs 78% (p = .007). In Gleason 8-10 tumors, 29 patients died of prostate cancer in the STAD vs 12 in the LTAD. A survival advantage is observed for LTAD in the subset of Gleason 8-10 T2C to T4 tumors with PSA < 150 ng/ml, and a DSS advantage is observed for the subset including all T3,4 or T2 Gleason 8-10 tumors.

This study supports the continued use and study of LTAD in patients with poorly differentiated or locally advanced prostate cancers.

Another study was conducted by the European Organization for Research and Treatment of Cancer (EORTC) Radiotherapy Cooperative Group. Results of the study showed that with a median follow-up of 61 months, overall survival rates for Zoladex with radiotherapy were significantly increased from 62 percent to 78 percent and disease-free survival rates were increased from 40 percent to 75 percent, when compared to the radiotherapy alone group.[1]

> For some time there has been an upper limit of about 70 Gray that can be administered. But new techniques and instruments can now safely deliver doses up to 78 Gy or more. A study of 149 patients who received a radiation dose of 70 Gy was compared to 151 patients who received 78 Gy. Forty-eight percent of the patients who received 70 Gy did not have rising PSA levels five years after treatment but 75 percent of those who received 78 Gy did not have a rising PSA.

Intensity Modulated Radiation Therapy

Intensity modulated radiation therapy (IMRT) is a safe way to accurately deliver high doses of radiation to the prostate while preserving normal tissue nearby, a new study shows. A study of 171 patients with early stage prostate cancer compared three-dimensional conformal radiation therapy (3D CRT) to intensity modulated radiation therapy (IMRT). The study found that when the radiation oncologists used either of the two techniques higher doses of radiation (81 Gy) could be used without significant urinary side effects. However, IMRT was more effective in avoiding the rectum and surrounding area. The risk of rectal bleeding two years after treatment was two percent for IMRT compared to 10 percent for conventional 3D CRT.

The IMRT system is produced by the Nomos Company at http://www.nomos.com.

There are several centers now using IMRT. One of the centers is the Cancer Treatment Centers of America-Call 1-800-788-8485 ext 5170 for more information.

Rising PSA

Radiation therapy is commonly employed to treat localized prostate cancer. Since the prostate remains and can be a source of PSA, there exists a great deal of debate in describing what constitutes failure. Several recent publications suggest that following successful external beam radiation or seed implants, patients who remain free of disease have an almost undetectable PSA level. There seems to be little argument that once the PSA begins to rise from a baseline level (called nadir level), that this constitutes failure. There are many things to consider when faced with a patient who exhibits a rising PSA after failed local therapy.

There is some evidence that there may be a PSA "bounce" within two years or so after radiation, either external or seed implants. The PSA may go to a very low level and stay there for some time, but then it may rise unexpectedly for a short time. This rise can be frightening, but in many cases it falls back down to a low nadir in a short time. However, if the PSA continues to rise, then it should be a matter of concern.

Since the person still has prostatic tissue it will produce a certain amount of PSA. There is some evidence that some of the tissue may recover from the radiation and begin growing again. Because of this the ultrasensitive PSA tests are of little benefit.

A ProstaScint test may be able to detect any metastatic colonies. If so, then additional radiation may able to destroy the colony. This treatment could only be used if the man has not had the radiation limit.

Usually hormone therapy would be the treatment of choice after radiation failure. If this does not control the PSA, it may be necessary to use chemotherapy.