PTCOG

Utilization Committee Report 1/23/86

The committee systematically reviewed the possible utilization of proton therapy for cancers of different type, location and stage. The approach examined briefly the justification, technique results and future studies required for ocular melanoma, chordoma, A-V malformations, prostate boost and lung.

Dr. S. Cohen presented an excellent review of the status of therapy (not proton) for ocular melanoma as background material for a Phase III clinical trial. He also prepared a bibliography of radiation retinopathy. Dr. M. Griem reviewed the utilization of particle therapy for A-V malformations, utilizing the data from Lawrence Berkeley Laboratory and itemized the potential use of protons for optic and brain stem gliomas, glioblastomas and medulloblastimia. Dr. Suit summarized the Harvard experience with ocular melanomas and chordomas and reviewed the current Phase III program of proton boost therapy for carcinoma of the prostate. He also itemized the possible use of protons for nasopharyngeal/pharyngeal carcinomas, paraortic node irradiation, bladder and renal cancers and sarcomas. Dr. Castro discussed the results obtained at Lawrence Berkeley Laboratory with particle therapy for ocular melanomas, pancreas and prostate and reviewed the new Phase III protocol for carcinoma of the bronchus. Dr. Munzenrider reviewed proton treatment approaches used for a variety of cancers at MGH. Dr. Archambeau indicated the feasibility of proton therapy and type of studies for carcinoma of anus, rectum, retinoblastoma and Hodgkins.

Cancers of selected type, stage and location were identified for which proton therapy was indicated and for which Phase I, II and II trials could be justified and established. The report of the intended rapid increase in the n umber of proton facilities suggests that, while a continued, careful evaluation to identify the most appropriate clinical utilization should continue, there is now an incentive to consider a more general application.

Summary of Accelerator Working Group Meeting on 1/22/86

The accelerator working group met with 14 participants to review its charges and to discuss various specifications relating to accelerator performance. Much of this discussion focused on recently provided data on intensity requirements. A summary of these discussions and those of previous meetings will be available for distribution within a few weeks.

A preliminary framework for evaluating proposals was reviewed and refined, but there is strong consensus that first a fixed set of accelerator performance specifications needs to be provided by the other working groups. The parameter of greatest importance at this time is the intensity. For example, is the intensity spec set by the requirement to treat very large treatment volumes on the order of 100 seconds, or by the requirement to perform a (possibly gated) treatment of a smaller volume in a much shorter time frame (even as short as 6 sec). If the very largest treatment volumes (e.g. 10 litres) comprise only a few percent of the anticipated patient load, can the treatment time be extended in these instances.

The accelerator working group needs quantitative guide lines on the above issues. The synchrotron designers are presently working with upper limits of 10-20 nA (“Goitein nA”) or ~3.5 to 7 x 10^{12} particles/minute. They have talked in terms of upgrade options to increase intensities beyond this range, but have pointed out that this would involve extra costs. The intensity parameter, then, could dictate a major decision in the choice of accelerator technology. Firm intensity guidelines should be in place to allow the machine designers time to make any necessary revisions before any evaluation process can begin.

Summary of the meeting of the PTCOG Facilities Working Group of January 22, 1986 L. Verhey 1/30/86

The Facilities Working Group of the PTCOG had a meeting of about four hours duration on the afternoon of January 22, 1986 at Fermilab. This meeting was primarily used for exchange of information relative to the reports, which individuals have made since the October 1985 meeting in St. Louis. This report is an attempt to summarize the main points covered during this meeting.

On the subject of energy degradation, Bill Chu explained that his somewhat pessimistic calculations of beam spoiling due to energy degradation did not explicitly take into account the fact that the patient-specific collimator could be placed very close to the patient, thereby minimizing this effect. Others mentioned that the distal falloff of the beam is also affected by the energy degradation with the distal 90 to 10% falloff being approximately 1.2% of the range of the particles as they are extracted from the machine. Miguel Awshalom claims that that is less of a problem if the energy selection is done after the energy degradation, that is before he last bending magnet. Others mentioned that we lose a lot of intensity with this technique. Obviously if the synchrotron is the machine of choice, energy degradation is not an issue since the machine is capable of selecting the energy desired. Although nothing has been submitted on the subject of the decoupling of the gantry in the accelerator, Michael Goitein made the statement that Harold Enge believes – that the gantry depends more critically on how the beam is steered out of the machine than the emittance of the beam once it exits the machine.

A discussion followed on the subject of dynamic therapy. Doe we want to be able to rotate a gantry with the beam on, and if so, is this a problem for superconducting magnets? This issue was not resolved. Lynn Verhey presented the results of his study on the number of oblique angles used in the MGH Clinic for Radiation Therapy as well as the angles used at the Cyclotron for patients under treatment in the last the months. This seems to indicate that one out of five or one out of six treatments wants an oblique beam directions which could be achieved only by a gantry or a very large number of fixed beams. He talked also about the desirability of having patients on the tables so that they could be scanned and planned using a conventional CT machine.

Bill Chu discussed the wobbler, which is currently being used at Bevalac for treating heavy ion patients. He described how the wobbler is used to paint six circles in order to get a uniform dose distribution. This technique loses about 50% of the beam. He showed a wobbler distribution from the Bevelac which looked very nice and flat, and mentioned that the magnets and power supply for the wobbler cost about $150,000. Miguel Awshalom said the Loma Linda machine will probably start with a passive double-scattering system with about 25% beam use and that scanning may be needed for the largest field sizes. Others mentioned that a gantry can always be used for fields up to 20 x20 or 25 x 20, and that the fixed horizontal-vertical beams be used for the largest field sizes. Michael Goitein drew a graph showing how the entrance dose of a spread out Bragg peak is a function of the effective source-to-skin distance and that a distance of less than 3 meters is unacceptable. It was also mentioned that a long, flat-top, low rep-rate machine such as the one being designed by Fermilab is relatively easy to use for scanning purposes, but that a high rep rate design such as Brobeck’s is more difficult to use for scanning. It is also true that or a high-intensity machine one does not have to do scanning at the beginning. Ken Thomas from Brobeck said that for a conventional synchrotron it was not much more expensive to produce a 20 nanoamp machine than a three to five nanoamp machine. Gabriel Lam from TRIUMF in Vancouver described their scanning system where the patient is scanned on the couch three-dimensionally with a 1.5 cm diameter beam spot. Their treatments are between thirty and forty-five minutes in length. The entire system cost them about $90,000.

A long discussion then ensued about how to convert from nanoamps in the machine to dose rate in the patient. At the end there was some general agreement of the following nature. For a 10 x 10 field treating at 10 cm depth, about 2×10^{11} protons must be extracted from the machine to give 1.8 Gy of radiation if a scanning technique is used, and about 9×10^{11} protons if a passive scattering technique is used. For the very largest fields such as Hodgkin’s disease, with a 40 x 40 field size and at 15 cm depth, about 1.2 x 1012 protons are needed to deliver 1.8 Gy if a scanning extraction is used, and 8.6×10^{12} if double scattering is used. A so-called 10 nanoamp internal beam machine gives a time average yield of 3.75×10^{12} protons per minute. Therefore in the two examples mentioned, the 10 x 10 x 10 field could be treated in about a quarter of a minute using a scattered beam or a twentieth of a minute using a scan beam, whereas the 40 x 40 x 15 field could be treated in about 5.8 minutes with a scattered beam and 1.3 minutes with a scan beam. Although there may be some discrepancy in these numbers, I think that most of the committee were in general agreement with these conclusions. Most of the synchrotrons being discussed, including the Fermilab machine, are claiming design current in the 10 to 20 nanoamp range.

In terms of beam monitoring, Miguel Awshalom defended his choice of SEMs since they are off-the-shelf items at Fermilab. Others questioned the choice since ionization chambers are both absolue and relatively inexpensive and easy to build. This question of how to monitor the beam has not yet been fully resolved. Bill Chu mentioned that he has designed a nd is now construction a multi-leaf collimator for the Bevelac beam at LBL. This will be an array of forty one-centimeter wide tantalum fingers each of which is capable of being positioned anywhere within the treatment field. The entire array will weigh about 600 pounds and will have a diameter of 160 cm. Bill estimates the total cost at about $60,000. This device would obviously be useful for scanning in range to spare entrance tissues. Bill also mentioned the desirability of doing proton CT if possible, but that an energy of substantially greater than 250 MeV, maybe as much as 350 MeV, would be needed in order to have transmission through the body at all points.

The meeting adjourned at about 6:30 pm without any true resolution of issues. On the other hand, the following list can be extracted as the list of facilities items which still must be settled upon:

1. Variable energy capability. This item affects beam sharpness and range straggling.

2. Gantry. This item, though expensive and complex, affect the flexibility of the facility and athe treatment sites which can be effectively irradiated.

3. Beam spreading techniques. This issue is affected by and in turn affects the specifications of the intensity and rep rate of the machine as well as dose homogeneity in the patients.