A-91-011
84-2
MP-00

CANCER RESEARCH AND TREATMENT CENTER
THE UNIVERSITY OF NEW MEXICO ☐ ALBUQUERQUE, NEW MEXICO 87131
900 CAMINO DE SALUD NE ☐ TELEPHONE 505 277-3631
H. Maskel Kelly, *Administrator*

713021

TO: Members, Committee on Human Trials of Pion Radiation Therapy, UNM/LASL

FROM: Morton M. Kligerman, M.D., Chairman MMK

DATE: June 1, 1977

SUBJECT: Minutes, Santa Fe Meeting

Attached are the minutes of our meeting in Santa Fe in April. The protocols are now being revised, and new copies will be sent to you soon. We are also compiling a listing of the treatment regimens for the protocols for your final review. If any of you have corrections or additions to the minutes, please let me know.

Thanks very much.

MMK:ft

attachment

MINUTES

Meeting of Committee on Human Trials
of Pion Radiation Therapy, UNM/LASL

Santa Fe/Los Alamos, New Mexico
April 7-8, 1977

Attending:

William C. Black, M.D.
Cancer Research and Treatment Center

Carl Bogardus, M.D.
University of Oklahoma Medical Center

James N. Bradbury, Ph.D.
Los Alamos Scientific Laboratory

Joseph Castro, M.D.
Mount Zion Hospital

J.M.W. Gibson, M.D.
British Columbia Cancer Institute

F. Bing Johnson, M.D.
University of Colorado Medical School

C. A. Kelsey, Ph.D.
Cancer Research and Treatment Center

M. M. Kligerman, M.D., Chairman
Cancer Research and Treatment Center

Kenneth Loeffler, M.D.
Northeast Ohio Conjoint Radiation Oncology Center

John Lyman, Ph.D.
Lawrence Berkeley Laboratories

Antolin Raventos, M.D.
University of California at Davis

John Senyszyn, M.D.
El Paso Cancer Treatment Center

Robert Stewart, M.D.
University of Utah Medical Center

Gary West, M.D.
Lackland Air Force Base, San Antonio, Tx.

John M. Yuhas, Ph.D.
Cancer Research and Treatment Center

Guest:

A. R. Smith, Ph.D.
Cancer Research and Treatment Center

General

Dr. Kligerman introduced new committee members, Dr. James N. Bradbury, Group Leader, Medium Energy Physics Division, Los Alamos Scientific Laboratory; and Dr. John Lyman, Medical Physicist, Lawrence Berkeley Laboratory, Berkeley, California. Dr. Alfred Smith, who leads the biomedical physics program for the UNM/LASL biomedical pion project, was also introduced.

The group discussed the policy of allowing no substitutes at the meetings, and agreed to continue the policy to avoid slowing down the work of the committee to orient persons who are acting as substitutes. The committee also voted to delete from membership persons who had not been able to actively participate in the past.

National Particle Therapy Report

Dr. Kligerman asked Dr. Stewart to speak to the committee regarding national policies affecting the particle therapy program. Dr. Stewart has recently been named chairman of the Particle Therapy Subcommittee of the Committee on Radiation Oncology Studies. Dr. Stewart recapped CROS efforts on behalf of particle therapy programs in the past, including sponsorship of the PART conferences. He stated that the National Cancer Institute is now in a position of reevaluating the particle therapy programs with a view toward infusing more funding into the effort in an attempt to show the value of particle therapy within a shorter time. He stated that the CROS is now developing a specific program plan for the NCI, which will be used to brief National Cancer Advisory Board members and other groups (e.g., members of Congress) involved in funding decisions.

He also said that to avoid any possible inference of conflict of interest while he is serving as chairman of the CROS subcommittee, he felt it necessary to resign his membership from the UNM/LASL committee. Dr. Kligerman accepted although it was agreed by the committee that Dr. Stewart should continue to attend the meetings as an observer, to collect information for the CROS and to bring CROS requests to the committee. Dr. Kligerman said he wished to appoint a representative from the University of Utah until Dr. Stewart feels free to rejoin the committee, to ensure continued cooperation and referrals to the pion program for appropriate patients. Dr. Stewart recommended the appointment of Dr. James Eltringham. (N.B.: Dr. Eltringham has accepted the appointment.)

Status Report, Pion Preclinical/Clinical Programs at LAMPF

1. Physics. Dr. Smith described beams developed for pion therapy at LAMPF. The beams currently in use are static in the lateral (x-y) dimensions, and dynamically shifted in depth by a hydraulic range-shifter. The beams can be tailored in all three dimensions, but a beam is not placed into use until sufficient biological and dosimetry data are obtained. The largest beam presently being used is 10 x 8 in the x-y dimension and has a z dimension of 8 cm in the peak. To obtain a more uniform biological effect across the 8 cm z dimension, the total dose is 25% greater at the start of the peak compared to the distal end of the peak. However, the slope of the distribution of stopping pions within the peak region is increased about 25 percent at the back as compared to the front of the peak.

Dr. Bradbury detailed plans for a swept fan tune, which would be used in concert with a scanning couch system (to be installed this summer). At the present current of 150 microamps, such a system would allow a beam of 4.4 rads/min in a volume 10 x 10 x 10 cm. At the final current of 1000 microamps (expected in 1979), this configuration would permit approximately 30 rads/min in a liter volume, as predicted by

LAMPF designers in 1971. At the outset, dose homogeneity of ± 10% will be accepted, although the beam can now be made arbitrarily uniform within ± 3%. A practical goal of ± 5% is sought.

Biology. Dr. Yuhas described work with two types of cellular systems--monolayers and multicellular tumor spheroids (MTS)--utilizing four different tunes. CHO cells and Line 1 lung carcinoma have been studied in monolayer. Studies of relative survival have indicated a shift to the left in the survival curve of 120-140 rads, but no change in the slope of the curve. This is significant in that CHO and Line 1 lung carcinoma are quite different in their sensitivity to radiation, yet the shift was of approximately the same size in number of rads. This would suggest that tissues with a small shoulder (such as most tumors) would recover relatively less efficiently than tissues with large shoulders (such as most normal tissues) during pion treatment, i.e., a constant number of rads equals a greater fraction of the shoulder region of the cell line with a small shoulder. This would result in a therapeutic gain.

The predictions of the reduced shoulders, namely reduced recovery, were tested directly with the physically flat 8 x 10 x 8 cm tune. Although the single dose studies failed to demonstrate a shoulder width difference among the positions tested across the peak, 24 hour fractionation studies showed clearly that cells exposed at all peak positions recovered far less than x-ray treated cells, but that the recovery inhibition was progressively more severe as depth in the peak increased.

Dr. Yuhas described a technique racently developed at the UNM/CRTC which allows the simplified production of MTS which possess the following characteristics of in vivo tumors: intimate cell/cell contacts, well-developed hypoxic regions; and altered cell cycle distributions. This system has been used to study effects of pions on tumors, until higher beam intensities allow a larger quantity of data to be derived from in vivo studies.

A variety of techniques have been developed to study the growth, behavior, and responses of MTS to therapy; for pion exposures the most adequate are delay in growth and "cure." These curves are similar to those found by Hugh Thomlinson in vivo. The growth delay studies with Line 1 MTS indicate a no-response region between 0 and 400 rads of x-rays, followed by a rapidly ascending relationship between dose and delay. Above a dose of 1000 x-ray rads, the relationship lessens, reflecting reduced efficiency in injury to the more radiation resistant hypoxic fraction. With pions, the shoulder region for Line 1 MTS is completely eradicated, and the RBE is dose dependent, declining with increasing dose. At about 1000 rads, the RBE again rises, reflecting more efficient injury to the hypoxic fraction, in comparison with x-rays.

In the "cure" experiments, the ability of MTS to grow out when placed on standard petri dishes is measured. Approximately 1.7 times as many x-ray rads as pion rads are required to yield a 50% "cure" for Line 1 spheroids.

Dr. Yuhas pointed out that studies are being done mainly with doses in the therapeutic range, and that statistically significant cell killing has been identified with pions at or above 40 rads. Plateau pions have been determined to be similar in effectiveness to x-rays. Studies with paired equal doses of peak pions have indicated greater cell killing than is apparent with single doses, or negative recovery. This has been observed with both CHO cells in monolayers and with mouse mammary carcinoma (MCA) MTS. An extensive study is now underway to observe the effects of single doses and 10 fractions of x-rays and pions on single MCA spheroids growing

individually in 14 wells of 24-well plates, with spheroid size measured at intervals to determine differences in recovery among the various treated groups and a control (unirradiated) group.

Mammalian studies of response of critical organ tissues to pions versus x-rays are continuing but sufficient new data were not available to report at the meeting.

Clinical Radiotherapy Pilot Studies. Dr. Kligerman described recent results with patients having lesions deep to the skin surface and in the head and neck. These patients were the first treated with a beam sloped physically in an attempt to make the peak region more isoeffective from the front to the back. One patient with a large submental mass, metastatic from malignant melanoma, was treated with a single anterior port 8 x 10 x 8, 15 fractions in 19 days. After eight days, it was noted that the patient was developing a second degree pseudodiphtheritic membrane on the floor of the mouth beginning about 4 cm from the midline. The front of the mouth was completely free of reaction. At the same time, the tumor mass seemed to be regressing more at the back than the front, and skin erythema in the posterior region of the mass was more pronounced. Bolus was added to shift the port 4 cm forward for three days, and afterward the patient received two anterior portals daily, such that about 2/3 of the remaining total dose was delivered with the peak depth shifted forward 4 cm. The day prior to the end of therapy, the patient developed a mucositis of the gums on both sides of the teeth, characterized by granularity and a pseudodiphtheritic membrane. The granularity persisted for approximately three months after therapy, until the patient's death from disseminated disease. Besides the granularity, a yellowish tinge to the gums was noted.

A second patient was treated at the same time for metastatic submandibular lesions, using lateral opposed ports abutting at the midline. This patient developed the same type of granular mucositis extending from the midline laterally for 4 cm. This granularity persisted at last observation (four months after treatment), but the patient was responding well to radiotherapy.

Dr. Kligerman said this was a unique reaction, which developed only where the mucous membrane directly overlaid bone, and is unlike any mucosal reaction he has observed previously with any type of radiation therapy. Dr. J. M. Sala, CRTC Radiation Oncology Chief, concurred in this unusual appearance.

A range-shifter function has now been developed which more evenly distributes stopping pions across the peak, and is demonstrating greater uniformity rad for rad, both clinically and biologically.

The LAMPF accelerator is now operating 25 days out of every 35, which makes it possible to accept patients virtually at any time. Patient work-up (including whole-body casting and CAT scanning for nonsuperficial lesions) is initiated, and therapy is started as soon as possible. The standard fractionation scheme in present use is 15 treatments in 19 days.

Dr. Kligerman said he is ready to accept patients with pelvic lesions (bladder, rectal, vaginal, ovarian, etc.), as well as head and neck, mediastinal, lung, and peripheral lesions. Patients may not have received previous radiotherapy to the treatment area. Advanced primary, recurrent, or metastatic lesions are acceptable. Patients should be ambulatory. Dr. Kligerman said he wants to treat at least six patients per cycle, until the fan beam is introduced, which will allow him to accept more cases per cycle.

A definitive skin study has been performed, with an RBE for pions of 1.4 established for the acute reactions. One patient with 15 skin lesions treated under that study now has recurrence of lesions treated by x-rays and pions at doses between 50 and 75 percent of a curative dose, with pions given at one-half the x-ray doses. The recurrences are being scored to determine time to regrowth for determination of tumor RBE.

Thus far, differential RBE values for pions are being observed for different normal tissues, approximately proportional to those observed with neutrons at Hammersmith. Dr. Kligerman believes that different types of normal tissues in the treatment field limit the radiotherapeutic dose. Therefore, he feels that introduction of normal tissue radioprotectants will be necessary to overcome differential in RBE for the normal tissues so that maximal tumor effect is possible. This is consistent with research at the CRTC with WR-2721 with which human toxology studies are about to begin.

Status Report, Vancouver Pion Project

Dr. Gibson reported that studies with skin nodules in patients may begin before the end of the year. Tissue culture work is progressing, and mammalian studies are planned, using mouse foot and pig bladder systems. X-ray studies in animals have been initiated, including irradiation of pig bladders with cobalt. Patient studies will concentrate on irradiation of bladder tumors, including early to late stages. Patients will be drawn from Vancouver and Alberta. A three-week treatment regimen is planned. Patients will be paired with previous cases treated with conventional radiation. If an appropriate case cannot be found for matching with a pion case, an appropriately matched case may be assigned to conventional therapy.

Dr. Gibson said they were considering using pion therapy as a boost to conventional therapy, to maximize the number of patients who might benefit from pions. Dr. Kligerman suggested they use pion therapy early, when the tumor mass is large and hypoxic, following with conventional therapy after the mass is smaller and better oxygenated. He said two LAMPF pion patients have been treated in this manner with good results, when he was limited by protocol or other factors in the amount of pion radiation that could be delivered.

Status Report, Berkeley Heavy Ion Project

Dr. Castro reported that helium ions have been in use clinically since July 1975. Twenty patients have been treated. The treatment planning techniques, assessment of inhomogeneities, and related efforts will be applicable to treatment with heavy ions, which is expected to begin late this year or early 1978. A significantly improved biological effect is expected with heavy ions, although helium ion treatment will be continued because of its favorable dose distribution. Tumors to be addressed are advanced head and neck, esophagus, pancreas, cervix, bladder, and brain (gliomas).

Dr. Lyman said the helium ion beam diameter is 27.5 cm maximum, and can cover most tumors. Static beams are being used, although scanning beams may be needed with heavy ions. Treatment times are 1-2 minutes for 20 cm fields. Diodes are being placed in body cavities when possible, so that measurements can be compared with calculations and CAT scan data. For thin patients, a stack of film is placed below the patient to attempt to assess shifts during breathing. With shallow respiration, not much shift is noted, but considerable shift is noted if the patient is asked to hold his breath.

The Berkeley group is developing a "read only" station for CAT scan tapes, so that information can be displayed on site.

CAT Scan Requirements

Dr. Castro stressed the urgent need for CAT scanning on-site at all the charged particle facilities. He said the need is far more critical for pions, heavy ions, and protons. He and Dr. Kligerman agreed that only CAT scanning can provide the information required to place the stopping region in the tumor volume, with adequate corrections for inhomogeneities. Also, CAT scanning during treatment would help to determine uniformity of regression, and changes in internal structures, so that "geographic miss" could be avoided. They asked Dr. Stewart to incorporate CAT scanning needs in his committee's report to the National Cancer Institute.

Dr. Kligerman said it took only the first CAT scan to realize that pion treatment of deep lesions couldn't be performed without CAT scans. LAMPF pion patients are now being sent to Denver, San Francisco, and San Antonio for CAT scans, since no machine is available in Albuquerque.

Dr. Smith presented the LAMPF requirements for CAT scans performed at the patient's home institution and has developed guidelines for distribution to committee members (see Attachment 1). These procedures are required to permit corrections for various tissue densitites (and stopping powers) and for construction of adequate bolus for inhomogeneity compensation. Dr. Kligerman noted that CAT units which allow patient scanning in the treatment position are required, and that means those with a wide aperature, namely 30" or so.

Autopsy Procedures

Dr. Black, pion pathologist of record, described the difficulty of obtaining appropriate tissues from autopsies on patients, and proposed a system which would simplify requirements of consulting pathologists who are performing autopsies. The process of reviewing the patient's chart (or multiple charts) prior to autopsy is time-consuming, and the most important information may not be readily apparent to the pathologist. He suggested development of a schematic form for each anatomic site (see preliminary example, Attachment 2), which could be completed by the radiotherapist at the end of treatment and forwarded to the referring physician for attachment to an autopsy permit. Upon the death of a patient, the physician could obtain the family's consent for autopsy and forward the permit and schematic form to the pathologist who was to perform the autopsy. The schematic form would include a perforated cardboard strip containing a letter code for various tissue blocks. The appropriate letter could be attached to the appropriate specimen and sent to the study center in Albuquerque. The group approved the proposal, and said they felt it could have wide applicability to all types of cooperative studies.

Protocol Modifications

All Protocols. The following changes were recommended for all protocols:

1. Ophthalmologic Assessment of Lens Opacity. An ophthalmologic evaluation to assess lens opacity prior to pion treatment and annually thereafter was recommended for all patients assigned to pion therapy, as a measure of assessing changes due to whole- body neutron dose. At present the neutron dose to patients at LAMPF is approximately 1 rem/hour, or less than 1/10 of 1% of total pion dose.

2. Clarifying Statement Regarding Pretreatment Evaluation Procedures. It was suggested that a clarifying statement be added at the beginning of the section in

each protocol for pretreatment evaluation procedures, noting that the procedures are required as good medical practice, not solely for purposes of the protocol. This is to ensure that third-party payers recognize the medical need for those procedures.

3. Follow-up Laboratory Tests. Follow-up procedures are to list laboratory tests as indicated, rather than specific tests.

4. Requirement for Follow-up CAT Scans. CAT scans are to be listed as a follow-up procedure when requested by the study center, with a note stating that follow-up CAT scans requested by the study center would be supported by research funds.

5. Reevaluation of Conventional Doses. Conventional doses for all Phase III protocols are to be summarized and submitted to the committee for reevaluation.

6. Extension of Follow-up Period. The present follow-up period specified in the protocols is three years, but the addition of a sentence was recommended stating that if data analysis warrants, follow-up will be extended to five years.

Miscellaneous Metastatic Lesions. The schema sentence regarding eligible patients was changed to read: "Patients with metastatic lesions originating from biopsy-proven solid tumors, whose projected survival is at least three months."

Head and Neck Protocols. A suggestion to eliminate T3 and T4 lesions from the larynx protocol was not adopted. It was agreed to maintain the protocols as written, except for general changes approved at this meeting and the previous meeting in Vancouver.

Pancreas. No changes were recommended other than the generally approved changes, except to require a CAT scan for pretreatment evaluation and follow-up. If data from current conventional studies indicate significant changes in survival in the future, the study may be changed to a randomized study at that time.

Prostate. The UICC staging was adopted for this protocol, and the treatment techniques suggested at the Vancouver meeting were adopted, specifying four-portal irradiation.

Rectum. The paragraph specifying criteria for resectability was deleted, in recognition of variability among surgeons. Chest tomographs were deemed unnecessary. Dr. Kligerman said he would resurvey his subcommittee to determine if selected patients with liver metastases should be included in the study.

Stomach. The protocol was changed to specify T4, N0-1, M0 as Stage II and T1-2-3-4, N2, M0 as Stage III. Tumors classified synonymously with gastric carcinoma were specified as acceptable for study, including anaplastic carcinoma, gelatinous carcinoma, linitus plastica, mucogenic carcinoma, signet ring carcinoma, undifferentiated carcinoma, and any other synonym.

Superior Sulcus. A description of pain was added as a specific request in the pretreatment history. CAT scans of the mediastinum and apical region were added to the pretreatment work-up. The conventional therapy regimen was expanded to include surgery and postoperative radiation, along with preoperative radiation and surgery or radiation alone. Doses for postoperative radiation therapy were left to the discretion of the participating institution.

Brain. Revised Phase II and III protocols were reviewed. The protocols required chemotherapy after pion therapy (with the Phase II protocol a nonrandom study and Phase III protocol a randomized study comparing pion/chemotherapy with conventional radiation/chemotherapy). The committee felt that the present Phase II protocols (covering all types of solid tumors, advanced primary, recurrent, or metastatic) were adequate, and that implementing a Phase II protocol for brain alone might require a special Phase II protocol for all anatomic sites. The group said they appreciated the work done by Dr. Frederick George and his subcommittee, but they felt that they would prefer to limit the protocol to pion therapy and allow chemotherapy to proceed at the discretion of the referring physician, recognizing that all patients would probably require some form of post-radiotherapy chemotherapy. They agreed that once acute effects on the brain due to pion therapy have been assessed, the suggestion of Dr. George's committee should be reevaluated for possible implementation. They also felt it would be best to limit eligibility to patients with classical gliomas, Grade III and IV, since adequate numbers of those patients appear to be available for study. They also recommended that the brain profile developed by Dr. George's group be incorporated into the pretreatment evaluation data forms. The protocol will be revised and resubmitted to the committee for final review.

Observation of Clinical Pion Therapy

The group met at Los Alamos to tour the LAMPF proton accelerator and observe pion patient therapy in progress. Dr. Smith gave an extensive review of treatment planning, use of CAT scan data, and construction of bolus and collimating devices. Dr. Kligerman described the system implemented at LAMPF for patient immobilization and positioning outside the treatment room. He said loss of valuable beam time at LAMPF for changing patients in the treatment room has been reduced to about 4 minutes (from 20 minutes) with the implementation of the system. He said he estimated that introduction of the system with conventional supervoltage equipment could significantly reduce patient costs by doubling the number of patients that could be treated per unit time. Dr. Kligerman noted that a module transferable to standard treatment couches to hold the patient, immobilizing cast, bolus, and collimator is under design, and delivery is expected soon.

Two patients under treatment were presented to the group in a tumor conference, and committee members queried the patients on the adequacy of their housing and personal arrangements while under treatment. Both patients and their spouses expressed satisfaction with the arrangements. After the meeting, some committee members toured the outpatient housing available for pion patients adjacent to the Los Alamos Medical Center.

ATTACHMENT 1
CAT Scanning Requirements for Pion Patients

We have found that it is essential to have CAT scans of pion patients so that we can design bolus which might compensate for tissue inhomogeneities and the irregular contours of tumor volumes. The CAT requirements for patients are individualized to such an extent that we cannot write general guidelines to cover all circumstances. We request that you call either Al Smith or Ken Hogstrom at the LAMPF Biomedical Facility (505-667-7115) after you and Dr. Kligerman have determined that your patient will be accepted for pion radiotherapy. Dr. Smith or Dr. Hogstrom will discuss with you the CAT scan requirements for your patient. Some general considerations are as follows:

1. The patient should be scanned in a position which simulates as closely as possible the eventual treatment position. If possible, pictures should be provided of the patient in the scanning position.

2. The patient should be tattooed with two reference marks which define the scanning axis (usually called the z axis) along which the sequential scans are taken. One of the tattoos should be at the level of the reference scan (usually called scan/slice number zero or one). Two additional tattoos along with the reference tattoo should define the scanning plane. These tattoos should be described in writing along with reference to anatomical landmarks. Pictures of the tattoos should be provided if possible.

3. X-ray localization films should be taken of the patient in the scanning position with opaque markers on the tattoos and a small solder wire running between the z axis tattoos. Another solder wire should be placed on the patient surface parallel to the first wire but displaced several centimeters so that the second wire is 90° displaced on the patient surface from the first wire. These wires should be kept in place during the CAT scans, hence the wires should be small enough so as not to cause artifacts in the data.

4. In general the scans should be taken 1.0 cm apart throughout the tumor volume and each scan should be referenced to the $z = 0$ tattoo. The scans should extend at least 2.0 cm each side of suspected tumor, although the CAT radiologist should be given freedom to extend scans.

5. The type of output required for each patient will vary. For all patients we need transparencies for each scan with scale factors which would allow these negatives to be printed to actual size. The transparencies should be taken at the gray scale setting which most clearly shows the tumor and surrounding tissue. There should be some reference marks on each picture which allows the image to be referenced to a fixed x-y axis in the scanning plane. Additional materials we may require are:

   a. Polaroid prints if available

   b. Tape containing the CAT data with a format description or phone number for an engineering representative from which that format information may be obtained.

   c. Hard-copy output (for all or only a portion of the scans) with description of pixel and voxel size and definition of numbers (i.e., $H_2O = 0$, Air = -1000).

   d. Hard-copy output of all pixels or data averaged over a specified number of pixels

6. There should be a description of the CAT scanning machine and a name and number for a radiologist and/or technician at the scanning site who may be consulted concerning diagnostic or technical questions. Also reference to an engineering representative would be useful.

7. A preliminary reading by the case radiologist should be sent with the CAT output and should be followed by a complete diagnostic report as soon as possible.

8. When possible please have the patient bring the CAT information with him. If that is not possible, the material should be sent to the Cancer Research and Treatment Center, c/o Selma Robertson, 900 Camino de Salud, N.E., University of New Mexico, Albuquerque, New Mexico 87131.

ATTACHMENT 2

POTENTIAL STUDIES: AUTOPSY MATERIAL FROM PION PROTOCOL PATIENTS

	TOPICS	TISSUES REQUIRED
I.	Effects of therapy upon the primary tumor (Qualitative & Quantitative)	
	A. At epicenter of treatment field	blocks from center of treated lesion (clips should help to localize)
	B. At perimeters of treatment field	blocks from margins of treated lesion (clips should help to localize)
II.	Effects on Vascular & connective tissue stroma . . .	As above
III.	Effects on contiguous organs	As appropriate; (blocks from non-treated tissues of identical type as controls).
	A. Skin	
	B. Bone Marrow	
	C. Spinal cord; brain	
	D. Other Vital organs	
IV.	Accuracy of treatment field localization (Spin-off from above)	
V.	?	

Problems: Localization of treated tissue volume for the pathologist

Pathologist interest

Feed back to submitting pathologists

Availability of material for study by other laboratories

CARCINOMA, HEAD OF PANCREAS

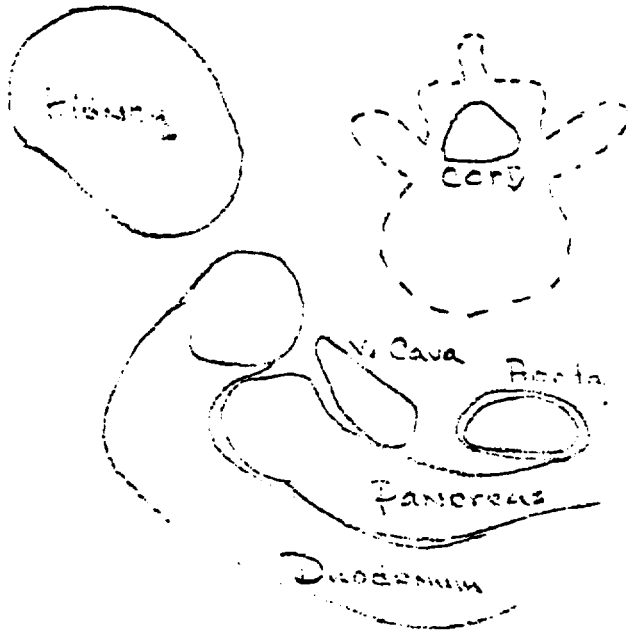
Patient Name: _____

Summary of Therapy: _____

Date completed: _____

Other Data:

Radiation Therapist: M. Klein



Maximum Dose

Periphery of Treated area

A B

C D

E F

G H

Other Important Blocks

A. Duodenum
B. Vena Cava & Aorta
C. Rt kidney
D. Liver - quadrate / gall bladder bed
E. ~~Stomach~~, distal
F. Spinal cord, L-1 through L-5
G. Transverse colon
H. marrow L-1 to L-5