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IN REPLY
REFER TO: MP-7

November 10, 1971

TO: Subcommittee on Radiation Therapy

Dear Subcommittee Member:

I want to coin two new terms to be used in our discussions of dose rate with negative pions:

Average Dose Rate (ADR) is the quantity to be used when calculating how long it will require to give a fraction. For example, if the ADR is 100 Rads/min, it will take 1 minute to give a 100 Rad fraction.

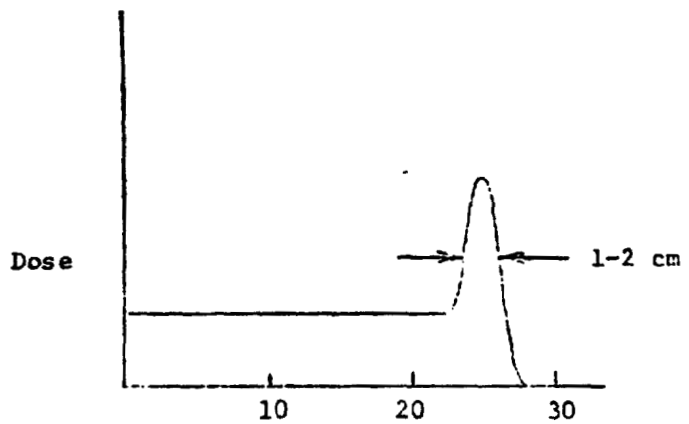
Local Dose Rate (LDR) is the rate at which a microscopic volume of tissue receives its dose.

ADR and LDR are not necessarily of the same magnitude, and in fact, in the case of depth scanning with pions, they are not of the same magnitude. I think this has not been clear in our discussions and is the basis of some confusion and misunderstanding.

When I have said that there is the possibility that, with the limited funds available, we might be able to achieve only on the order of 20 Rads/min in a 15 x 15 x 12 cm thick target volume, I have been referring to the ADR.

What we propose is to sweep the pion stopping region peak, which has a thickness of the order of 1-2 cm, through the thickness of the target volume. The figure below illustrates this.

Now, what is the LDR? If we were very pessimistic and said that the ADR were only 10 Rads/min and that the thickness of the peak were 2 cm, then we would have the following situation. The 2-cm-thick peak would have to move in six 2-cm steps through the 12-cm-thick target volume. If you are going to give 10 Rads exposure, i.e., take 1 min. to go through the target volume, then the stopping region will stay at each of the six depths for only 1/6 min. (Don't worry! This is an idealization. The motion would be practically continuous. There will



be no problem of abutting adjacent stopping region peaks.) But it is giving 10 Rads to the local tissue in this 1/6 min. Therefore, the LDR seen by the tissue is 10 Rad/1/6 min = 60 Rad/min. This seems to be well out of the low dose rate regime in which some of you are concerned about effects of ongoing cell repair during irradiation.

What about patient immobilization? If, as many of you suggest, fractions of the order of 100-200 Rads will be given with this high RBE radiation, then 20 Rads/min. ADR implies immobilization times of 5-10 min.

I gather that most of you feel that development of better patient immobilization techniques should be an important part of this project. If so, my impression is that to immobilize a patient for 5-10 min. or even significantly longer is certainly not an insurmountable problem.

I would appreciate your comments if any seem in order.

Sincerely,

Dick

RICHARD HUTSON, Co-Chmn.
Facility & Beam Line
Subcommittee

RH:pat
Distribution: See Page 3.

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