The Radiopathologic Basis for Atmospheric Oxygen Breathing in Radiotherapy

P.

Rubin

From the Department of Radiology, University of Rochester

A "supervascularization" phenomenon of irradiated regressing tumors has been demonstrated by the use of correlative microangiographic and histologic techniques in transplanted rat tumors. This supervascularization effect is more consistently seen with tumor regression after fractionated dose schedules.

The vasculature of both tumors and normal tissues tends to be fragmented despite regression after large single doses.

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A radiosensitive tumor is redefined as one in which the usual daily dose (200 RJ^{SO} R) is effective in differentially destroying neoplastic cells but not tumor capillaries, allowing for the selective absorption of tumor cells and resulting in a relative increase in vasculature and thereby tumor oxygenation.

A review of recent clinical studies using oxygen probes suggests that tumor oxygen tension is higher in tumors after irradiation has been completed, in patients breathing air and one atmosphere of oxygen, as compared to before treatment.

It seems essential in the radioresponsive tumor to preserve present fractionation schemes in radiotherapy since, as a result of regression and supervascularization, they allow for better oxygenated cell populations for each subsequent fractional dose of radiation in many instances. In hyperbaric oxygenation programs, the gain in increasing tissue oxygenation by high pressure breathing may be offset by large fractional increments that can damage capillaries in tumors and lead to tumor anoxia despite regression. Also, damage to the vasculature of normal tissues is probable and may effect the therapeutic ration unfavourably.

It is for these reasons that a program of atmospheric oxygen breathing by mask, in which preservation of present fractionation dose schedule is more easily allowed, is being explored.

The early clinical results are suggestive of an augmented therapeutic response and justify further evaluation of this treatment technique.

From the University of Washington School of Medicine, Seattle

Physical Characteristics of a One-Man Hyperbaric Oxygen Chamber

By P. Wootton

Clinical use of hyperbaric oxygen as a radiotherapeutic adjuvant is being explored at the University of Washington Medical School using a transparent double-walled Vickers Research Hyperbaric Chamber licensed by the State Boiler Commission. The useful mechanical and radiation life of the transparent sleeve is set several orders of magnitude lower than the known ultimate life.

The chamber is supplied with means of aural, visual and telemetric contact with the patient. Temperature, humidity and purity of respired gas are controlled by high-volume flow of oxygen. Barotrauma is minimized by the use of smooth motorized controls, permitting pressurization in 8' and decompression in 5' in relative comfort for the average patient. Maneuverability of the chamber has been enhanced by local provision of a Quick Disconnect System. The transparent chamber wall transmits 80 % of Co60 gamma radiation and 60 % of X-rays having a half value layer of 2 mm Cu. It modifies the electron buildup at the skin giving dosimetric grounds for expecting enhanced skin reactions within the chamber irrespective of the pressure of hyperbaric oxygen. For angulations of the beam used at this hospital the light localizer is a valid analogue of the gamma ray beam in the chamber.