Physical Characteristics of a One-Man Hyperbaric Oxygen Chamber

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From the University of Washington School of Medicine, Seattle

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.

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Except for the surface doses, dose distributions in tissue within the chamber may be determined with the use of isodose curves as measured outside the chamber.

The accuracy of the procedure is limited by the same factors as dosimetry outside the chamber. The curvature of the wall is not a significant factor.

If reduced fractions are employed, accuracy of dosimetry becomes crucial. In vivo dose measurement is desirable, and corrections of standard data for inhomogeneities and finite size of the patient become mandatory.

From the Manitoba Cancer Treatment and Research Foundation, Winnipeg, Manitoba
Physical Problems of Co60 Therapy using a Hyperbaric Oxygen Tank By A. F. Hollo way and E. M. Campbell

The Manitoba Cancer Foundation has been using a Vickers Oxygen Tank for approximately 20 months in conjunction with a commercial fixed field type of Co00 beam therapy apparatus for radiotherapy of selected patients. The combination of these two pieces of equipment has necessitated modifications in our beam direction equipment as well as changes in the customary source skin distance.

In addition, the perspex wall of the tank has introduced certain problems. The first of these is connected with the use of light beams for localizing the treated area. Measurements have shown

that this may be neglected for all practical cases in radiotherapy. The discolouration of the tank for a total patient (tumour) dose of about a quarter megarad has also been found not to be a serious problem.

A second problem is concerned with the correction of given dose-rates for absorption in the perspex wall of the cylinder. Our investigations have shown that this correction varies with field size from 22% to 14%. Accordingly charts have been prepared for each field size at two different S.S.D.'s, giving the diaphragm setting and the absorbed dose-rate in rads/minute. These dose-rates, of course, refer to the dose-rate on the central axis of the beam for the given S.S.D., at a depth of 0.5 cm in tissue.

The final problem which we have considered relates to the surface ionization ratio and the effect of increased pressure in the tank. Some clinical evidence suggested that there might indeed be an increased surface ionization ratio. Investigations by Howarth [1] also indicated that increased gas pressure might result in an larger surface ionization ratio. Preliminary measurements have been made with a thin-window ionization chamber in a steel pressure vessel which suggest that the surface ionization ratio may be increased by as much as a factor of 2 for small fields if the pressure inside the tank varies from air at atmospheric pressure to air at 30 pounds per square inch. However

the magnitude of the effect would appear to be such that little clinical effect would be expected.