A TECHNIC FOR INTENSIVE ROENTGEN IRRADIATION OF THE NECK

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The radiation treatment of intra-oral cancer involves technics combining intra-oral radium applications directly to the primary seat of the disease and external radiation to the glandular regions of the neck.

The problem of the primary lesion has been successfully met by electrosurgical methods, radium seed implantations directly into and about the site of the disease, and by heavily filtered radium applicators immediately in contact with the diseased tissues (1).

External radiation to the glandular region of the neck is generally considered essential even in the absence of palpable nodes. Heavily filtered radium packs applied over long periods of time—200 to 300 hours (1)—and short wavelength roentgen rays in massive and divided doses have been widely used with a moderate degree of success. Isolated nodes have been treated successfully with gold seed radon implantations and also with platinum needles (0.5 mm. wall thickness), using weak intensities (1 mgm. per 15 mm. length of needle) over continuous periods of six to seven days.

The ideal procedure for treating cervical metastases is still a mooted question. Block dissection in the absence of palpable nodes is rapidly being abandoned, while adherents of block dissection in the presence of enlarged nodes are gradually showing preference for radiation first. When the nodes are fixed, and with bilateral involvement, there is no choice other than radiation.

Whether radiation be employed preoperatively or postoperatively, or only as a palliative procedure, the fundamental principle is dosage to the limit of skin tolerance as well as the physical tolerance of the individual. At least 2 skin erythema doses (2 E.S.D.) of high-voltage roentgen rays can be administered through the skin to the primary tumor site in the mouth or throat. When this quantity of radiation from without is supplemented by interstitial and contact radium applicators, intensities approxi-
mating 5 to 10 E.S.D. can readily be attained. It is obviously not possible to deliver such intensities to all parts of the glandular structure because of the profound caustic effects, and the variable response of glandular metastases, depending on the cellular characters, which cannot always be defined by the microscopic picture.

The successful irradiation of the neck involves a distribution of equal intensities throughout all regions. The primary tumor, as well as the regional glands, must receive a homogeneous distribution.

It was found that a mass of tissue corresponding to the average diameter of the neck or face could be charted with isodose curves to obtain a homogeneous distribution of irradiation throughout all parts, providing four fields were employed so that the beam to each field could overlap the beams of the adjacent fields (Fig. 1).

A perpendicular passed through the center of each beam forms a right angle with the perpendiculars projected through the adjacent beams. Four fields—anterior, posterior, and right and left lateral—are irradiated. The position of the head is fixed so that the sagittal plane maintains a fixed relation to the perpendicular axis of the body (Fig. 2).
All intra-oral lesions are treated with the center of the beam directed to the level of the lobe of the ear (Fig. 2, A). The only lead protection used is: (a) over the eyes; (b) over the hair in the lateral and posterior exposures at a level of one-half inch above the pinnae of the ears; (c) over the lips; (d) over the thyroid cartilage (the lead is moulded and covers an area 3 x 5 cm.).

For laryngeal lesions the center of the beam of radiation is directed to the thyroid cartilage (Fig. 2, B). This level is maintained for all four fields. No lead protection is used for a field 16 x 16 cm. except over the hair line, lips, and eyes, as in intra-oral lesions, as described above.

The factors employed are as follows: mechanical rectification; water-cooled tube; 30 ma.; 50 cm. distance; 0.5 mm. Cu + 1 mm. Al filtration; field about 20 x 16 cm. The erythema dose equals 800 r units (as measured in air). The total radiation on the skin (and about all parts of the neck, tumor site, and glandular structures) is 225 per cent E.S.D., or 1800 r units, which is the total of the applied overlapping and transmitted radiation.

The method of obtaining the sum total skin intensity resulting from the four direct beams, as well as the overlapping and transmitted radiation, is as follows. An anatomical cross section is drawn at the level of the desired central point of irradiation and
enlarged according to the exact measurements of the patient to be treated; an isodose chart is applied to each of four portals anterior, posterior, right and left lateral. The depth dose to any part of the neck from all four fields can readily be ascertained (2). The isodose charts from four fields at right angles to each other will show that the total skin intensity is practically the same as the depth intensity and represents a homogeneous distribution of the radiation throughout the irradiated area.

By clinical observation on a series of 47 cases, the maximum safe dose which can be administered, within a period of eight or ten days, has been found to be 225 per cent E.S.D. or 1800 r units (as measured in air) to every part of the skin surface of the neck. Fig. 3 illustrates a cross section showing the summation of intensities about all parts of the field. Each skin intensity represents 100 per cent direct radiation.

In order to establish the total amount of irradiation to be applied to each skin area for a neck of given dimensions, it is necessary to obtain the ratio of the desired 225 per cent E.S.D. to the skin intensity obtained from the anatomical cross section when the isodose curves have been applied at right angles from four overlapping fields. For example, if the total intensity from four fields in the given case is more than 225 per cent, then less than 100 per cent E.S.D. of the primary radiation to each of four fields is given; on the other hand, if the size of the field is such that less than 225 per cent skin intensity is obtained from the total through each of four skin areas, then the total dose to be applied to the skin of each of four portals must be in excess of 100 per cent E.S.D. The average skin intensity in the center of the skin surface of each field in Fig. 3 is 224 per cent. The ratio of 225 per cent to 224 per cent is approximately 100 per cent, which represents the dose of the primary radiation that must be applied to each skin area. If the intensity is shown to be 250 per cent, the ratio (225 per cent to 250 per cent) is 90 per cent, which represents the dose of primary radiation to be applied to each of four skin areas in this case.

In order to deliver a total of 225 per cent E.S.D. to each of four skin areas, it was found practical to divide the treatments so that 15 per cent E.S.D. was delivered to each area at one sitting, making a total irradiation of 60 per cent E.S.D. to be administered on one day. This treatment was repeated every other day for five, six, or seven treatments, according to the diameter of the neck.

In the average case the skin intensity, as well as the tumor intensity, of 225 per cent was attained in about six days. In only very stout individuals was it necessary to go on to the eighth treatment.
The insert diagram in Fig. 3 shows the difference between the radiation intensity on the skin as measured in air and the summation of the administered and transmitted radiations at various depths as determined with water phantom measurements, including scattered radiation in the tissues. This variation is balanced by the difference in the inverse-square law. The difference was found to be 3.2 per cent, and is so small that for practical purposes it should not be considered of any significance.

The skin reactions for intensities of 225 per cent ranged from a faint to a fiery redness appearing within ten to fourteen days after treatment. In many instances there was vesiculation. Doses in excess of 225 per cent skin intensity within ten days usually resulted in desquamation. If, for unavoidable reasons, the treatment time extended beyond fourteen days, there was usually less skin reaction. The mucous lining membrane of the lips, cheeks, and tongue showed a more intense whitish discoloration with desquamation than was proportionate to the skin reactions. Dryness of the mouth and laryngeal irritation are common, but not especially distressing.

The results cannot be interpreted on any statistical basis. The palliative benefits have been better than with any other technic employed by us up to the present time. All of the 47 patients treated had inoperable cervical glands.

In conclusion it may be said that the technic described admits of a homogeneous distribution of radiation to all parts of the field, so that the primary lesion at any point, as well as the regional glands, will receive an equal intensity. This technic is suitable for extremities approximating the size of the neck or face. The divided dose permits greater total intensities by extending the treatments over a period of eight to ten days, and therefore gives the advantage of radiating tissues during different stages of cell division.

REFERENCES


DISCUSSION

Dr. John T. Farrell, Jr. (Philadelphia, Pa.): May I ask how much reaction takes place in the mucous membrane of the mouth, the maxillary antrum, and in the tongue, following this massive radiation? Do these tissues ever go on to ulceration? Does the dose used refer to the dose in the tumor and include all radiation, or does it refer only to the dose applied to the skin?
DR. S. J. HAWLEY (Danville, Pa.): I think there is a valuable lesson in this paper, the lesson of giving large enough doses. One of the reasons for failure of roentgen therapy has been the fear of giving too large a dose. Dr. Widmann has worked out a method of giving a large dose to the glands of the neck, which is important in treating a serious condition, such as metastatic cancer.

MR. WEATHERWAX: I do not know how well I can answer Dr. Farrell's question. Dr. Widmann could answer it very much better. I believe we do get reactions in the mouth which are rather intense, but these clear up nicely. We have never had any severe reaction which persisted any length of time.

We think, as Dr. Hawley says, that it is important to get rather a large quantity of radiation into the tumor area or throughout the tumor area, if we are to attain the best results. This technic lends itself to giving a maximum quantity of radiation throughout the neck with as little damage as possible to the skin. In cases in which we treat a number of portals at one sitting, we can deliver greater quantities of radiation to the skin.

We attempt to deliver our total dose throughout the tumor within about two weeks' time, following the saturation technic. A 100 per cent E.S.D. is equivalent to 800 r as measured in air and does not include back scattering. We take into consideration all overlapping dose and transmitted radiation, but do not consider back scattering in stating the number of roentgens.