treatment versus length of controls the r.b.e. values were about the same in mice of one and three weeks old at the time of irradiation. For the ratio actual growth versus potential growth, r.b.e. values were higher for 3-week-old mice. In general, the r.b.e. values decrease from about 4 at a dose of 250 rad neutrons to about 2 at a dose of 900 rad.

R.b.e. and energy spectra of d + T neutrons as a function of depth in a human phantom

1611 A

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Fast neutrons of various energies, including 15 MeV neutrons generated in the d + T reaction are now applied at a number of radiotherapy centres in clinical trials to investigate their usefulness.

The preference of one energy range instead of others is still a subject of discussion. One of the interesting characteristics in this evaluation is the possible variation in effectiveness with penetration depth resulting from energy changes in the primary beam.

The degeneration of the original beam with increasing depth was derived from energy-fluence spectra measured with a proton-recoil scintillation spectrometer and from lineal energy spectra measured with a tissue-equivalent proportional counter.

The r.b.e. of the d + T neutrons for survival of cultured cells of human kidney origin was determined along the central axis at different depths and outside the penumbra in a phantom. No significant changes in r.b.e. for the various positions were observed. These results are discussed in relation to the neutron spectrometry data.

Build-up and depth-dose characteristics of different fast-neutron beams relevant for radiotherapy

1612 A

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For radiotherapeutic applications of fast-neutron beams, two aspects are of primary importance, notably, the build-up of the dose below the skin surface and the central axis depth-dose distribution. The skin reactions of patients irradiated with d + T or d(17) + Be neutrons are comparable; however, physical measurements of build-up characteristics reported in the literature for these neutron beams show considerable differences.

Build-up measurements were performed with a thin-walled (1·0 mg/cm^2) ionization chamber for neutron beams produced by the d + T, d(50) + Be and p(42) + Be reactions. The charged-particle build-up curves are determined to a great extent by the experimental measuring conditions. Measurements carried out for normal radiotherapy situations, i.e., the collimator opening covered with a lead layer have shown that the entrance dose is approximately 60 per cent of the dose at maximum for all three neutron beams. However, for the d(50) + Be and p(42) + Be neutrons, the maximum of the build-up curves is reached only at approximate thicknesses of 7 mm and 10–15 mm, respectively. This implies a relatively lower dose to the subcutaneous tissue than for the d + T situation, where the maximum is reached at 2·5 mm.

Central axis depth-dose curves have been obtained for d(50) + Be neuotrns at an SSD of 129 cm, for p(42) + Be neutrons at an SSD of 125 cm and for d + T neutrons and ^{60}Co gamma rays at an SSD of 80 cm; resulting in 50 per cent dose values at depths of 12·7, 13·5, 9·7 and 12·7 cm, respectively, for approximate field sizes of 15 cm × 20 cm. The p + Be reaction will provide the same advantages as the d + Be reaction for comparable energies of the bombarding particles, although for the same current considerably lower dose-rates are obtained with the first reaction.