Techniques in microwave and radiofrequency heating of tissues

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The band of frequencies in the electromagnetic spectrum which is of use in heating tissue at depth was discussed. The methods that may be used to heat tissues were described and the advantages and disadvantages of such methods outlined. The possibility of producing microwave-induced internal hot-spots in a target whose dimensions are comparable to the wavelength of the radiation, and the relevance of this to the heating of small animals, were discussed. The advantages of microwave contact applicators were outlined and two such devices described. Finally, some of the problems associated with temperature measurement in the presence of electromagnetic fields were stated, and brief descriptions of new kinds of thermometers which enable reliable temperature measurements to be made in such an environment were given.

Decreased circulation in tumours as a result of hyperthermia

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The ' sandwich ' tumour system is very suitable for investigations concerning the effect of hyperthermia on tumours. The ' sandwich ' system consists of a 200 μ thick tumour growing in the rat subcutis in a sheet-like fashion between a micro base-plate and a glass cover-slip. The tumour tissue in such a preparation is sufficiently transparent to allow the visualization of the micro-circulation. Its limited thickness and its contact with the glass and mica make it relatively easy to heat the entire tumour by means of a current of hot air. The results of 21 experiments (42·5°C tumour temperature for 3 hours) show that two-thirds of the tumours treated in this way show a cessation in the micro-circulation of the central part of the tumours. The periphery and the tumour environments seem to be unaffected. Those areas showing circulatory failure exhibit necrosis the next day. The exposure time required for this effect seems to be of the order of 140 min, with a standard deviation of about 60 min.

Hyperthermia adjuvant to radiotherapy of a murine mammary carcinoma

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The effects of a combination treatment consisting of irradiation followed by heat treatment were studied in mice. Small M8013X tumours, implanted subcutaneously in a hind leg of mice, were treated. Tumour growth delay was used as parameter. The effects on the tumours were compared with the effects on the skin of mouse feet. The latter were evaluated using the scoring system of Douglas and Fowler (1976).

Hyperthermia was applied by immersing the legs with or without tumour in heated water. The standard heat treatment used was 60 min at 43°C. This produced hardly any visible damage to the skin apart from some redness and oedema immediately after treatment. Longer treatments did produce persisting damage to the feet, qualitatively different from the damage after irradiation.

The heat treatment of 60 min, if started immediately after irradiation, enhanced the radiation effect on the skin by a dose-modifying factor of 1·8. With increasing interval between irradiation and heat, this factor decreased. No enhancement was observed if the interval was longer than three hours.