A Method For Interstitial Thermoradiotheapy - Preliminary Clinical Results.

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The use of hyperthermia as a therapeutic modality is rapidly gaining recognition;however, the homogeneous heating of deep and large or inaccessible tumors is still technically difficult. Strohbehn (1982) proposed interstitially implanted antenna arrays, energized by RF microwaves or with co-implantation of radioactive sources for thermoradiotherapy. Theroretical consideration of the radiobiological properties of low dose irradiation suggest a possible therapeutic advantage for interstitial implants particularly in conjunction with hyperthermia. Gerner (1983) showed a significant radiation dose rate dependence of heat radiosensitization, with maximum effect at the very low dose rate associated with interstitial thermoradiotherapy.

Manning (1982) reported on 25 patients given 30 minutes RF hyperthermia at 43-45°C prior to Ir 192 treatment, with 63% complete response, Vora (1982) achieved a 68% complete response in 16 lesions using the same technique. Both authors found interstitial thermo-radiotherapy to be both safe and effective. Other techniques for interstitial hyperthermia have been described (Joseph 1981, Astrahan 1982), and safely used in a few patients.

A system for interstitial radiotherapy with hyperthermia has been devised* using microwave induced heat delivered through a series of interstitial antennae introduced into the usual plastic carriers. The system can operate at 915 or 300 MHz, the lower frequency being used when more penetration of the microwaves is desired either because of a larger implant volume or bigger inter-antennae spacing. A special feature is air cooling of the antennae jackets which avoids adjacent hot spot formation, progressively important as the inter-antenna spacing increases. The system has been found to be safe in animal experiments and provides uniform heating throughout the implant volume in phantom and animal studies (Bicher 1984).

The microwave antenna is inserted into the plastic carrier and air flow provided through a tube that caps the other end. The system employs an array of 4 or 8 antennae. 300 MHz antennae are used in larger implants with inter-antennae spacing more than 2 cm.

Thermometry is performed during every patient treatment employing microthermocouples (100 micron)* implanted in tumor, in normal tissue, and inserted in tubes in other tumor areas. Tumor temperature is maintained at 42-45°C for one hour at each treatment. Temperatures are measured at 3-5 minute intervals with "power off" conditions to eliminate possible microwave interference artifacts.

Patients are entered into a protocol designed to assess the therapeutic enhancement of hyperthermia and dependence of effect on the number of hyperthermia treatments. Low dose rate Ir 192 therapy is given in 2 loadings a week apart (total dose 3000-5000 rad) and up to 4 times in the intervening week following a 100-200 rad teletherapy dose.

Patients have plastic implant tubes in place for two weeks during the treatment course. Most have been outpatients in the week between Ir 192 loadings.

* Equipment supplied by PDM, Panorama City, CA.

Treatments are well tolerated using air cooling. A fibrotic reaction replaced tumor in three patients, including 2 large tumors (melanoma, fibrosarcoma) that had failed external thermoradiotherapy. A tumor at base of tongue, after failing both radiation and external thermoradiotherapy also had no response to 2800 rad Ir plus 400 rad X-ray therapy and 8 interstitial hyperthermia treatments. Of 9 patients evaluable at two months post treatment 6 showed a complete and 2 a partial tumor response.

Effectiveness of interstitial hyperthermia cannot be concluded from this limited study. It is interesting that 2 large tumors (melanoma, fibrosarcoma) recurred after partial response to external thermoradiotherapy then regressed completely with interstitial thermoradiotherapy. Air cooling is important not only for better uniformity but to prevent thermal burns. Initially air flow was started only when patients reported pain or discomfort, and resulting in alleviation. Subsequently we have initiated air flow from the beginning of treatment and patients have rarely had discomfort.

Interstitial treatment provides more uniform distribution, particularly in large tumors, and is the only way to adequately heat superficial tumors poorly accessible to external applicators. Our protocol, which delivers during two weeks up to 5000 rad interstitial plus 800 rad external radiation and 8 interstitial hyperthermia fractions, appears to be both safe and effective.

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