INCREASE IN X-RAY SENSITIVITY OF CANCER AFTER EXPOSURE TO 434 MHz ELECTROMAGNETIC RADIATION.

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Abstract.

The proportion of cancer cells killed by using H-wave polarised 434 MHz electromagnetic radiation applied fifteen minutes before low doses (50 to 80 rads) of X-radiation (140, 220, 330 KV, 4 MeV and Co^{60} sources) is between three and over one hundred times better than X-radiation alone. This increased sensitivity to X-radiation varies with the cancer's site, with the physical features of host and cancer, with the cancer growth rate, with the 434 MHz dose delivered and absorbed, with the normothermic X-radiation sensitivity and other as yet unknown factors. Fifty-two patients with E.N.T. cancer treated by combined therapy and compared with similar retrospective series treated in air at normothermic levels and a series treated under three atmospheres hyperbaric oxygenation, show primary clearances rates of 81%, 32% and 61% respectively. Longer survival is correspondingly improved.

The increased radiation sensitivity is partly thermal but chiefly nonthermal in origin. Temperature measurements reveal a maximum differential rise of over 3.0^{0}C. in large avascular cancers. X-radiation sensitivity of some cancers after 434 MHz radiation remains enhanced for approximately thirty minutes even when the cancer is cooled to pre 434 MHz temperature. A second period of increased X-radiation sensitivity appears to exist between approximately twenty and thirty hours after 434 MHz radiation.

Methods and Equipment.

434 MHz radiowaves have been delivered using standard radiating antennae, coaxial cables and 200 Watt 433.69 MHz generators manufactured in West Germany[1]. Curved dipole antennae ("mould" radiators), longer straight dipole antennae and small circular antennae have been used in various situations. A unit of twelve generators and antennae produced by W. Guettner in West Germany under the trade name "Tronado" is in use for whole body therapy[2]. Depth dose[3], energy absorption[4], and reflection patterns have been established in the early 1960's using animal tissues (Fig.1). It is unknown whether these parameters apply to living tissues; effects on deep seated cancers suggest that the depth dose in the living is greater than these experiments reveal.

The radiating antennae are designed to produce the maximum H-wave component because this decreases skin heating, increases the depth dose and produces the most uniform tissue field strengths[5].

Power drawn by a generator varies by less than 1% when an antenna is irradiating air, the whole or part of a normal person. Introducing a cancer near the antenna increases the power drawn and decreases the strength of the scattered electromagnetic radiation field. The best clinical results occur when the patient is treated so that either of these effects are at a peak. In cancer of the maxilla (cheekbone), the power rises by approximately 15% when the antenna is 3 cms from the cheek, falls to 2% rise at 10 cms away when compared with similar distances from a normal maxilla. The coupling between the antenna and the cancer is thus critical but easily made optimum. Delivery of 434 MHz radiation is optimised by using a receiving antenna, amplifier and rectifier to drive a direct recording voltmeter to indicate the levels of reflected power from the patient. When the therapy antennae are correctly positioned in relation to the cancer the reflected radiowave signal strength is at a minimum. Zero setting of the voltmeter is achieved using normal subjects. All cancer patients to date have revealed that their 434 MHz radiowave reflections are different from normal people. In some cases,when patients have achieved complete clinical regression, the 434 MHz radiowave reflection pattern has returned to apparent normality (Fig. 2). The changes in radiowave reflection pattern and absorbed power caused by a cancer ceases within one to two minutes of death. This effect is thought to be due to the interaction of 434 MHz and charged radicals present in cancer cells[6].

Our apparatus has not damaged any organ except the skin. A total of 140 hours of irradiation to one patient's skull over six weeks, (three or more hours per day) had no effect on regrowth of hair which was recovering after X-radiation therapy, healing of wounds, mental or physical activity of the brain, personality or special sense organ changes. No patient has developed cataract or visual changes. Headaches and eye pains due to sudden expansion of fluid can be completely avoided by using acetazolamide, one-half gram orally, two hours before treatment, (or by intravenous injection). Three patients have had skin burns; in each case the area was very close to a deposit of cancer beneath and very close to the antenna. Nearly one thousand patients have been treated. Erbe generators have been used for twenty years in Europe for physiotherapy without any complications being reported. Skin burning does not occur with physiotherapeutic exposures in non-cancerous patients.

Temperature Measurements.

Superficial cancers have been monitored using infra red thermography or thermocouples inserted into a nylon sheath preplaced in cancer and temperatures one-half minute and more after cessation of 434 MHz are recorded. The maximum measured

temperature rise has been 3.5°C. in a large avascular mass; the temperature rise recorded in normal tissue outside the cancer being 1.0°C. This proves that at this frequency differential heating of cancer tissue can be achieved. At 27 MHz differential heating of cancer occurs, its presence increases the radiowave generator output and decreases the scattered radiowave field strength also but the effect on cancer differs from the effect of 434 MHz.

The increase in radiosensitivity of a cancer after 27 MHz radiation is much poorer than at 434 MHz. It reaches a maximum of about three, coinciding with the maximum temperature and is approximately the same as that produced from simple whole body hyperthermia by Pettigrew's wax bath method[7] to 41.8°C. Simple experiments using superficial cancers whereby the 434 MHz radiation was delivered, the cancers cooled to their pre-treatment temperature and then given X-ray therapy show that the radiation sensitivity is not solely dependent upon the temperature. Such sensitivity persists for up to thirty minutes after 434 MHz radiation even when the cancer is at normal temperature. No such residual sensitivity can be discovered using 27 MHz; this frequency has therefore been abandoned for clinical use in our practice. Several clinical therapeutic failures are attributed to the trial of 27 MHz as a radiosensitising agent.

Cancer Growth.

The growth of all cancers can be expressed as a Gompertzian equation of the form

$$N_t = N_o e^{\frac{A}{a}(1-e^{-at})} \quad \ldots\ldots\ldots(1)$$

where N_t = number of cancer cells at time t, N_o = number of cells at time zero, A is a constant reflecting the growth rate and a is the rate of deceleration of the growth rate with time. This equation applies to cancers which form solid tumours. The deceleration of the growth rate occurs when the cells of the solid masses are not equally exposed to nutriments. In the special case of non solid or diffusely growing cancers (most leukaemias), the equation becomes

$$N_t = N_o e^{At} \quad \text{(i.e. } a = 0\text{)}$$

A is then seen to be related to the doubling time (T_2) of the cancer population by the equation

$$A = \frac{.693}{T_2}$$

Cancer Destruction by X-Rays.

Reduction of a cancer cell population as a result of X-ray therapy conforms to the general equation.

$$N_r = N_t(1-(1-e^{-\frac{D}{D_o}})^x)^y \quad \ldots\ldots\ldots(2)$$

where N_r = residual cell population after N_t cells have been treated by y doses of D rads. D_o is the radiosensitivity constant of the cancer (defined as that single dose of D_o rads required to reduce N_t to $\frac{N_t}{e}$ or to approximately 35%. x is the extrapolation number of the cancer (defined as the number of targets in each cell which require simultaneous destruction to cause death). x can be extrapolated from the curve relating cell kill/ X-ray dose.

X-Radiation Sensitisers.

To cure cancer N_r has to be brought to zero. Since D, y and N_t are the human features which govern the tolerance of the patient, D_o and x must each be as small as possible. The previous best radiosensitiser known was oxygen which can reduce D_o by a maximum factor of 2.7. Our results of X-ray therapy at 41.8°C. (simple wax bath hyperthermia) reveal that this reduces D_o by a similar factor.

After 434 MHz the factor of reduction of D_o varies from 3.0 to several hundred. Since we know that 434 MHz does not elevate the temperature above 41°C. and we have shown that at the 41.8°C. D_o is reduced to a third, one must conclude that at this frequency both thermal and nonthermal effects occur and that the nonthermal effects predominate. At 27 MHz, there is no evidence that there are nonthermal effects on cancer tissues.

The figures for D_o have been calculated assuming x = 2, for the series of 156 treated E.N.T. cancers. Since most are squamous cell cancers for which x is known to be 2, this probably yields reasonably correct results for D_o. It has been shown that x can be reduced by the application of heat[8], and until experimental work reveals the value of x, the possible variations of D_o are unknown. However, even assuming that 434 MHz reduces x to 1, the discrepancies between D_o at 41.8°C. and D_o after 434 MHz radiation remain so great that the effect cannot be by simple hyperthermia alone.

Results.

3 groups of 52 patients each, all proven to be suffering from E.N.T. cancer were treated by Drs. Holt, Leckie and Nelson.

Table 1.

Staging.

Group	1	2	3
T3 or T4	26	23	26
T2, or recurrent	23	26	23
N+ (histologically positive nodes)	31	37	28
N_2 or N_3	23	26	20
Total	52	52	52

Table 2.

Primary Site of Origin.

Group	1	2	3
Salivary carcinomata	2	4	1
Sinuses, ear	2	0	5
Nose, nasopharynx	4	3	2
Palate	2	6	6
Tonsil	9	5	9
Tongue	6	10	5
Mouth	4	4	5
Pharynx	8	6	10
Larynx	6	7	7
Pyriform fossa	9	7	2
Total	52	52	52

Table 3.

Methods, Results and Radiosensitivity (D_o) Values.

Group	1	2	3
Method of therapy	Megavoltage X-Rs. in air; 37°C.	Megavoltage X-Rays under 3 A. Hyperbar. Oxyg. 37°C.	Megavoltage X-Rays comb. with 434 MHz radiowave in air
Resolution of primary (T) and Nodes (N) by primary method	17 =32%	32 =61%	42 =81%
Limited implant to residual primary and/or nodes	2	0	7
Clinical control of T and N by above procedure	19 =36%	32 =61%	49 =94%
Recurrences at one year	8/19 =42%	12/32 =37%	9/42 =23%
Subsequent recurrences during second year	3/19	5/32	4/40
Dead during first year	63% 33/52	42% 22/52	29% 12/42
Dead during first and second years from cancer	71% 36/52	63% 33/52	42% 17/40
Dead cancer free	1	2	3
Median X-ray dose	6000 rads over 6 weeks	3500 rads (7x500 r) or (6x600 r)	4600 rads over 8 weeks
Average radiosensitivity by calculation D_o value	161 rads	60 rads	9 rads

Twenty-four hours after the application of 434 MHz radiowaves, there appears to be a further increase in sensitivity. It is difficult to explore clinically but appears to lie between twenty and thirty hours post radiation. X-radiation at this time is very effective clinically and conventional doses of 200 to 800 rads produce rapid tumour shrinkage. This may be due to the 434 MHz radiowaves plus X-ray therapy having killed all the sensitive cells at the first application and the remainder converted to a synchronously growing colony. Under these conditions, twenty to thirty hours later may merely be a time at which X-ray therapy is fortuitously more effective than usual, with perhaps all cells in mitosis or some other stage of cell development.

Conclusions.

The use of 434 MHz H-wave polarised electromagnetic waves has been shown to be the best radiosensitiser yet discovered. This effect is mainly nonthermal, although this frequency radiation does produce thermal changes in cancer. An empirical schedule for treating E.N.T. cancer has produced excellent preliminary results. Further development of physical techniques of measurement and application of such waves is urgently awaited. This frequency E.M.radiation holds the further promise of an effective diagnostic method, which does not depend upon previously accepted criteria and the capability for much improved therapeutic results.

Acknowledgments.

To those doctors who referred patients for this type of therapy, to my partners, Dr. A.J.M. Nelson and Dr. P. R. Leckie, for their help and permission to report their patients and to the staff of the radiotherapy practice for carrying out these proceedures.

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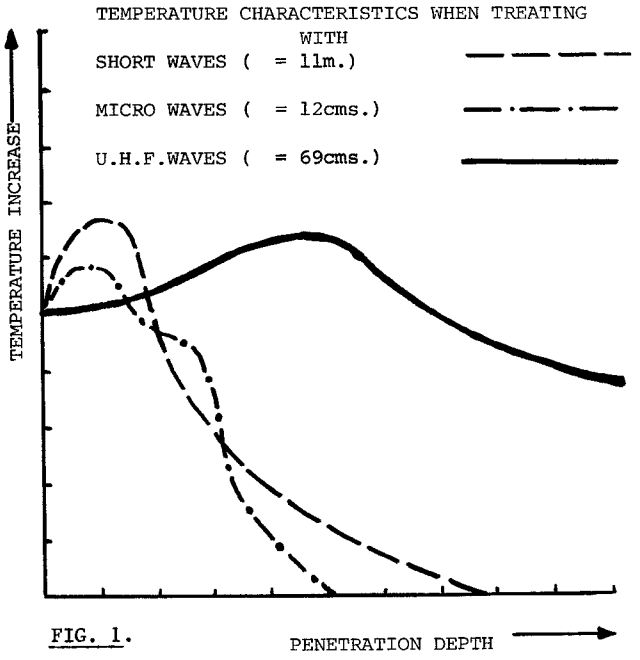

FIG. 1.

Fig. 1. These curves were plotted from measurements in dead tissues which did not contain cancer. There appears to be reasonable penetration of 434 Mhz radiation to 10 cms or more depth. From Erbe Elektromedizin publications.

(FIG. 2)

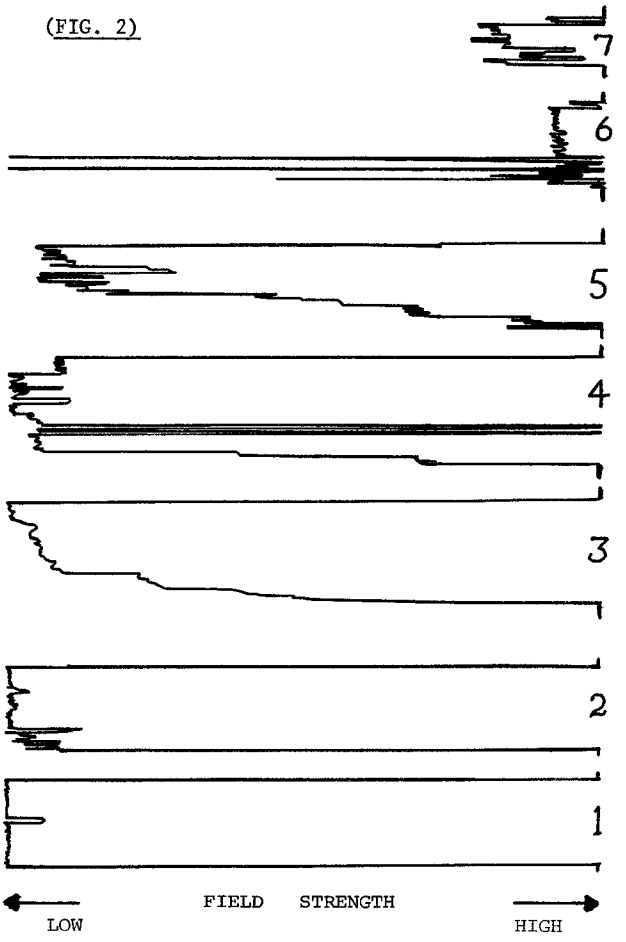

Fig. 2. (Shown on next page).
Recordings of field strengths around a patient with widespread lymphosarcoma.
Treatment sessions 1 and 2 were on the 1st day, 10 minutes each, 20 minutes separation between each.
Session 3 on the 2nd day lasted 15 minutes.
Sessions 4 and 5 were of 12 and 10 minutes respectively, with 20 minutes separation on day 3.
Sessions 6 and 7 were on day 4, 12 minutes each with 20 minutes separation.
On day 1, this patient's blood and bone marrow were grossly abnormal from lymphocyte excess in each organ. Note that the tracing shows a low field strength of ambient stray 434 MHz radiation at all the times the therapy antennae were emitting.
Day 2 (No.3) and Day 3 (Nos.4 and 5) show

(Figure 2 - Ctd.)

a change in the pattern with times of higher stray field strength.
On day 4 the chart approaches a "normal" tracing during Session 6. It is almost "normal" in Session 7.
On day 5, his haematology was improving.
One week later his blood lymphocyte count was normal, all clinical evidence of disease (nodes, liver, spleen) had disappeared.
One month later the abnormal lymphocytes had disappeared from his marrow.
His marrow and blood remained "normal" for six months (i.e. no proven malignant lymphocytes in either) but aplastic from prior alternate therapy (X-radiation and cytotoxics over the previous 4 years).
He died later from meningitis and postmortem failed to prove active malignancy.