

4. CONCLUSION:

Still Palatography is now a well established radiographic technique for evaluating speech defects due to palatal or pharyngeal causes. When available, cine palatography will provide added information regarding swiftness of soft palate movements and clearer impression of pharyngeal wall contraction. The technique is fairly simple, does not require

any more elaborate equipment than the standard X-ray machine available in many general hospitals in this country. It only requires an interested competent Radiographer who will quickly acquire the intricacies with little more training either here in Enugu or of course overseas.

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BIOLOGICAL IMPLICATIONS OF NATIONAL NUCLEAR POTENTIAL

By

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As far back as 1947, radioactivity was identified with Tin Mine industry in Plateau State of Nigeria by the Geological and Survey Division of the United Kingdom Atomic Energy Commission. The presence of Uranium and Thorium were confirmed as principal sources of radioactivity. Following this discovery, a 'Radiation Protection Panel' was set up in 1958 by the Federal Government to advise it on their biological implications, under the auspices of the Federal Ministry of Health. Subsequently, Nigeria took up membership of International Atomic Energy Agency.

Presently Nigeria is a possible exporter of Thorium. As though this does not hold enough

potential for nuclear capability, the great growth in Nigeria industrial and technological development brings to focus the inadequacies of the conventional sources of energy, namely fossil fuel energy and Hydroenergy. The third possible source of energy - solar energy has been suggested as a possible source of power supply to augment the services of NEPA.

However, experts suggest that this is not only economically too much a drain on our gross national product (GNP) but also we lack the technological sophistication it demands. We are therefore left with one alternative, namely nuclear energy. Recently the Federal Military Government endorsed this forecast. Nigeria is therefore geared for a take off of Nuclear or Atomic Industry. The products of the

Atomic Energy Industry viz: radiation, nuclear heat, electricity will be used in the operation of the various arms of our other giant and small industries. Already in some countries like U.S.A. and USSR. nuclear energy is being used to propel ships and submarines too.

But, promising as these might be, the nuclear potentialities have a lot of health or biological implications and obligations. I shall now proceed to analyse them. Our tools will include ionising radiations from X-Ray and radioisotopes in our Hospitals. Nuclear reactors or Atomic Industry have as their by-products ionising radiations, and radioactive materials. Uranium is a radioactive substance used in nuclear reactors, whose disintegration is triggered by artificial or spontaneous neutron capture from Cosmic rays or other sources. Radioactive substances disintegrate to emit several radiations like alpha rays, Gamma, and Beta rays. Radioisotopes are by-products. It is the hazards of these products that are a grave concern for the survival of man. Their effects on life are enormous.

Effects on Genes: Radiation induces two types of genetic changes namely point mutation and chromosomal aberration. Point mutation are represented by linear dose curves and usually it is a product of single hit event whereas chromosomal aberration are exponential in nature and result from more than one hit event. Using either assessment of visible recessive mutations at the marked foci known as specific locus method or counting of the sex-linked recessive lethals, linear relationship between radiation dose and the yield in mutation within low dose range irradiation can be ascertained.

In biological systems, dose-rate effects on mutation induction effect cells having high metabolic activity for example germ cells and haematopoietic cells.

The changes that can occur are mitotic delay or inhibition, production of degenerated cells and/or survival of the organism.

One of the simple means of radiation protection in man is lowering of radiation intensity. The effects of fractionated high dose tends to parallel the effect of continuous reduced dose because a process of repair takes place in the sublethally damaged targets of irradiated cells. The interval between two irradiations is important. It has been observed that 500R given in 12 or 24 hour interval produced increase in mutation compared with 10,000R in a single dose irradiation as the time interval is small. Fractionated irradiation reduces the opportunity for the interaction of the effects of radiation with body chemicals, or metabolites. It increases the chance of the repair of sublethal damages. If synchronisation of a particular stage in cell cycle with time of irradiation can be attained this has radiation effect-reduction advantage. For instance irradiation of spermatids. This can be achieved at a long interval between two irradiations.

Chemical Control of radiation: It has been observed that in the absence of oxygen tension, the effects of irradiation are diminished; that is to say, oxygen acts as dose enhancing agent. Indeed the common call by radiographers for a 'deep breath-in' is not scientifically defensible, nor the seldom practice of X-Raying patients while in oxygen tube, mask or tent. Two reducing agents have been proposed to counter the effects of oxygen namely sodium hydrosulphite which removes oxygen and sulphhydryl compounds such as cysteine and cysteamine which act not only to remove oxygen but as effective scavengers of active radicals formed by irradiation.

Sensitivity to radiation:

Here much of our results are from experimental animals but their correlation with human beings have also been noted.

It is known that 85R of gamma rays delivered at low fractionated dose can induce sterility in rabbits. Russel (1959) and Oakberg (1962) estimated the Ld-50 of stage one oocytes to be 8.4R and stage two as 9.4R in mouse.

By mathematical interpolation, human sensitivity to radiations are similar to that of mouse. Baker and Beamont (1967) showed that the effect of 5000R in monkeys corresponds to 15R in mouse. The International Commission on Radiation Protection (ICRP) No.8 of 1966 report shows that IR induces leukaemia in 10 to 20 persons in every 10^6 persons so irradiated, while 10R produces leukaemia in one person in every 10^4 persons so irradiated. Indeed, whole body irradiation carries leukaemia risk of 30%, Carcinoma of Thyroid risk of 50% and other malignant diseases a risk of 20%.

Effects on pre-natal development: If pregnant subjects are irradiated with 200-300R daily from the 7th to 12th day of pregnancy, the baby or offspring of the pregnancy usually develop hydrocephalus if the irradiation is from 9th to 11th day of pregnancy while that irradiated from 7th to 9th day develop microcephalus. L.B. Russel and W. Russell (1952) emphasised the importance of limiting X-Ray examination and radiotherapy involving the uterus to two weeks immediately following the end of menstrual period. In 1959, Hammer and Jacobsen noted the importance of radiological investigation involving the pelvis of fertile women and said that such investigations should be carried out during the first ten days following a regular menstruation of normal intensity and duration. The ICRP recommendation of 1959 and revised in 1962 and 1964 approved the views of Hammer and Jacobsen. Rugh and Grupp (1959-62) and Ohzu (1965) observed that even low dose radiation of 5R

can cause gross anomalies like exencephalia if administered 12-36 hours following conception (mating). Hicks and D'Amato (1963) reported that a single dose of x-radiation of 10-40R to a rat on the day after birth caused anomalies in the brain.

Nigeria's nuclear potential exposes her to a grave responsibility in the crusade to ensure safety of her populace. She has to contend with the problem of transportation of radioactive materials, under radiation proof condition. She has to contend with the meteorological problems of North Easterly (N.E.) wind that brings harmattan for over four months in the year and the opposite directional South Westerly (S.W.) wind that brings rain for more than half the year. She has to ensure accident free Nuclear reactor power plant. She has to have ready at hand efficient manpower and technological know-how capable of coping with evacuation of citizens around site in case of accident and capable of providing adequate medical facilities it entails. She has to contend with the problem of extricating politics in decision of siting of the industry, relying solely on scientific parameters in siting of the nuclear power plant for example, consideration should be given to the effects of prevailing winds and the rainfall pattern as these are capable of carrying airborne radioactive dusts from the reactor site to populated areas. A case in point is the effect of the prevailing winds like the harmattan winds blowing from a Thorium content region - the Sahara Desert on the vegetation and people of this country. Gaseous effluents from reactors may contain radioisotopes of gases such as argon-14, Krypton-85, Xenon-133, radioiodines-129 and Iodine-131, tritium and oxides of carbon-14.

There is every need to limit radiation to as much as possible to the natural background dose level to which man

has been exposed for thousands of years. The natural radiation sources include cosmic rays, radium in the earth, natural radioisotopes like potassium-40 and carbon-14 taken in with food.

There are two parts of entry of radiation to the human body. He may receive on the surface of the body by exposure to cosmic ray, a piece of radioactive materials inhaled or eaten or otherwise ingested. Should accident occur in nuclear plant, such as the Windscale pile in U.K. in 1957, the major area of problem is in radioactive cloud produced. This moves in the downwind direction. The effects will naturally be attenuated over a long distance from the site. There will be direct radiation, and there will be internal radiation from radioactive materials which are either inhaled or ingested. The external radiation may be within MPD. The main concern is from ingestion like radioisotope Iodine-131 which on entering the body chemistry gets concentrated into the thyroid gland. Radioactive substances can settle on foods in shops, on vegetables, grasses and later find themselves eaten by grazing animals. Milk from such animals like cows can then be a source of radiation in man when consumed by him. In Nigeria because of the Sahara Thorium and possible Uranium dusts which can find their way to this country during harmattan, research is now going on (headed by Professor O.L.V. Ekpechi) on Iodine study from thyroid glands of cows from Plateau State of Nigeria where radioactive substances have been associated with Tin Mines in that area. I think the research should be extended to milk from cows in this area. Efforts should be made to keep population low around the

suspected mine area by setting up residential and commercial buildings at distances of about two miles away from the Tin Mines. The general population around the mine area should be medically monitored every six months if we must avoid radiation hazards. Other isotopes like Strontium-89, Strontium-90, Caesium-137 should be watched closely.

The primary way in which high energy radiation affects tissue is to produce ionization along the paths of the rays. The ions result from the forcible removal of electrons from molecules leaving electrically charged fragments of molecules and atoms. The production of ions in living cells can harm the cells in two ways namely, (a) actual disruption of chromosomes, membranes, etc., (b) Recombination of molecular fragments to form compounds like hydrogen peroxide which acts as cells poisons e.g. by interfering with enzyme action. It is the later process or reaction which produces somatic effects like altered blood count, anaemia, lowered resistance to infection, loss of clotting action, loss of hair, etc. etc.

In my early article on the subject entitled "The nation and radiation threat" and published in part in Daily Times of November 29, 1978 at Page 21, I dwelt on radiation at the diagnostic level of operation, which hardly reaches LD50. In the present work my attention is focused on high intensity radiation. The reason for this is that our government now appreciates the dynamic exponential growth both in our population and on our energy needs. Hence the Atomic Energy Commission has been set up. It becomes therefore necessary to alert our government and our Scientists on the obligation to ensure safety. Excuses such as "low water level of River Niger (Kainji) for poor electricity supply will be too costly in an atomic reactor. The increase in incidents of cancer in Nigeria calls for establishment of Radiotherapy Centres in more of our Hospitals and high Radiation intensity will

be needed. Radioisotopes for medical use are needed in this country now. We need to produce them locally in the interest of verile economy.

HAEMATOLOGICAL EFFECTS

High intensity irradiation can cause blood aplasia even if it involves only a small part of haematopoietic tissue. The result of this is anaemia and leukopaenia. The surprising thing about this state of affairs is that this happens even when little or no bone marrow is irradiated in the process. This is why low blood count must be viewed with some concern in radiation workers. The mechanism of the incident seems to be accountable as being due to a progressive depletion of the protected bone marrow by the migration of cells from the protected zones into the irradiated ones. This being the case the use of lead shields for protection of vital (gonads) organs does not ensure normal blood counts in radiation workers. A corollary of this dictum is to dispel the notion that low blood counts in radiation workers is a sign of injudicious use of lead aprons. It is encouraging to note that recovery or haematopietic equilibrium is reached after a period of rest away from radiation in most cases. It is necessary that (a) radiation workers should have regular annual or bi-annual differential blood count (b) have an annual leave of not less than thirty days for thirty-hour-working week, be supplied with one pint of milk each daily. In Nigeria where radiation workers work for forty hours a week, the annual leave should be forty days.

Another biological technique for estimation of absorbed radiation is chromosome aberration study using a simple blood culture technique of Moorhead since circulating lymphocytes are in their pre-DNA-synthesis stage of cell cycle and induced aberrations

are of chromosome type as opposed to chromatid type. (Bender and Gooch, 1962). I have suggested laboratory monitoring as possible biological dosimeter in Nigeria since the methods are cheaper and more reliable than the physical dosimeters - Ionization chamber and film badges. Here, I must quote at length the result obtained from biological dosimetry carried out on sixty two (62) out of 120 radiation workers, in the Institute of Medicine and Pharmaceutics, Iassy Romania. "Between the year 1957-1967, the Institute followed up the dynamics of haematological changes in 62 individuals of 120 staff of the Roentgenologic (Radiological) department of Iassy. Among them 29 have shown haematologic abnormalities and 23 have displayed the subjective clinical symptoms ascribable to a radiation environment, usually less than 50mR per month.

White Cell Results:

In 8 cases who worked for $1\frac{1}{2}$ -3 years, the leukocyte

- counts diminished to 1800-3000 while initial counts was 5000-7000.
- Neutropoenia revealed 39-56%.
- Lymphocytosis between 42 and 27%.
- Toxic granulation in polynuclear cells and monocytes were found in white cells.

In 3 Cases

- eosinophilia is between 8 and 16%.

In another 3 cases who were younger,

- promyelocytes was found in haemogram.

In 2 Cases

- Thrombocytopenia is 80,000-60,000 counts with prolongations of clotting and bleeding times.

In the stage of leukopoenia there was increase in size of leukocytes, tending to

segmentation, and staining of lymphocytes. The red blood cell showed no significant changes. Clinical symptoms presented were dizziness, headache, nausea, and menstrual disturbances in females.

On leaving X-Ray department leukocytes returned to normal within 6-8 months. On resuming work, the changes reappeared in 1-6 months. 7 persons were advised to leave their job and change their profession.

Among the remainder of the investigation persons, 21 displayed leukocyte counts ranging from 4,000-6,000 without other blood changes, whereas in the remaining 23 leukocyte counts were persistently over 6,000"

If such staggering figures are obtainable in technologically more developed Rumanian hospital, then the lot of radiation workers and the general population in Nigeria surely provides matter for speculation.

For one thing out-dated but renovated radiation machines are often sent to developing countries for purchase or as economic aids. Secondly Uranium and Thorium presence has

been established in Nigeria following exploratory investigation by Geological Survey Division of UKAEC since 1947. Nigeria has the potential for Thorium exportation. Thirdly Atomic or Nuclear Reactor is the only long term answer to Nigerian energy problems. Finally, the need for the use of radioactive isotopes for diagnosis and therapeutics has arisen in our hospitals.

The Federal Government is discharging her social and economic responsibilities by trying to avail our country the fruits of scientific and technological advancement. With the presence of radioactive materials in our midst, and the formation of the "Atomic Energy Commission" by the Federal Military Government it is our hope that before the commissioning of the later, a meaningful and detailed consideration of the safety aspects of nuclear paraphernalia should be looked into. Experts from our Universities, medical physicists, radiologists, radiographers and similar groups should be involved in such deliberations.

7th March, 1979

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