RADIATION PROTECTION PROBLEMS IN THE PRACTICE OF RADIOTHERAPY IN NIGERIA

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Abstract

Many radiation protection problems have been identified in the practice of radiotherapy in Nigeria. The majority of these arise as a result of non-availability of essential equipment. Others are due to breakdown of equipment as a result of lack of spare parts and necessary expertise for maintenance. Recommendations are made for tackling these problems and these include regional cooperation with exchange of human and material resources between institutions.

1. Introduction

The radiation protection of patients receiving radiotherapy involves the accurate delivery of the prescribed radiation dose to the tumour while avoiding as much as possible the irradiation of healthy tissues [1].

In order to achieve these objectives, there must be proper guidelines with respect to the dosimeter, treatment planning, patient positioning, choice of equipment, equipment design and performance, radiation quality assurance and personnel training and experience. For a period of 20-30 years there have been only two radiotherapy centres in the country (both with Cobalt 60 equipment) serving a population of 100 million people. They have largely operated with equipment installed at the time of establishment. The IAEA has over the last 10 years provided some technical assistance to the country for the improvement of radiotherapy services. Two additional government centres will commence operation soon while a private centre was opened over a year ago.

2. Dosimetry aspect

Radiation delivery must involve accurate knowledge of radiation output characteristics from the therapy unit. Radiation output from the equipment must be calibrated regularly at least annually using a more recent international code of practice for absorbed dose determination and the results cross-checked by taking part in the IAEA/WHO Postal Dose Intercomparison using TLD capsules [2]. In addition, the reference or standard ionization chamber with the electrometer in use must be calibrated against a primary standard for various photon energies available in the centre. This dosimetry equipment should be re-calibrated once every two or three years in a standardizing laboratory for accuracy while a constancy check must be performed occasionally using a suitable radioactive source check.

It is also necessary to have a beam data acquisition system for producing isodose charges and evaluation of dose distribution for each treatment condition required in treatment planning procedures. It will be useful to have the beam data linked to a treatment-planning computer.

Presently, dosimetry equipment are not readily available for calibration of radiotherapy equipment and plotting radiation profiles and isodose curves. Radiation output determination from the Cobalt 60 equipment is based in most cases on decay factors from previous calibration and IAEA TLD intercomparison studies.
3. Quality Assurance

Quality assurance is very essential to the safety and effective treatment of patients in radiotherapy. There should be periodic checks on beam symmetry, uniformity and flatness as recommended in the protocols used for the quality control programme [3] [4].

4. Treatment Planning

This involves a consideration of the beam quality, accurate dose delivery, beam directional and modification devices and patient's positioning. There should be a uniform dose distribution to the target volume within 5% [5] [6] variation while every effort must be made to limit radiation dose to surrounding tissues to the minimum levels using beam shaping devices and making allowance in dosimetry plans for tissues with different densities.

Patient's contour and internal structure information must be accurately determined. These can be achieved using a simulator and a CT scanner linked to a computerised treatment planning system. In centres where these are not available, some gadgets like solder and callipers, multi-pin device or pantograph will help limit errors in obtaining patient's outline compared with the use of lead strips.

Each Radiotherapy Department must have essential accessories and good mould room facilities to aid patient's planning, positioning and protection. These include beam directional and modification devices, like beam direction shells, wedges, lead shields. Mechanical and optical alignment devices should be essential parts of every therapy equipment.

The 2 old radiotherapy centres in Nigeria do not have many of these facilities. Radiation plannings are still manually done. There are very few wedges and isodose curves. Radiation planning is done based on clinical parameters only with the risk of some inaccuracy in the definition of the target organ and unnecessary irradiation of normal structures.

5. Limitations in provision and designs of equipment

(a) **Superficial Therapy:** There are no orthovoltage and Linear Accelerator for superficial therapy of skin cancers and especially Keloid lesions, which are very common in Nigerians. Therefore, in many cases Cobalt 60 machines are used with boluses to increase skin dose. This gives unnecessary irradiation to normal deep sealed organs.

(b) **Cobalt 60 Equipment:** The only working Cobalt 60 machine in Lagos has a solid couch thus precluding undercouch treatment and accurate replication of parallel A-P opposed fields. This may cause wrong areas to be radiated when patient turns.

(c) **Brachytherapy:** The department uses a curietron machine for the treatment of cervical cancer, which is the second most common female cancer in Nigeria. There are no rectal dose meters to assess correctly doses received during intracavitary insertion. Radiation doses and distribution are determined using plain radiographs to calculate doses to Points A & B. A computer planning system will give more accurate results.
6. Recommendations

(a) Increased technical assistance to third world countries to help acquire essential equipment.
(b) There should be standardization in the design of radiotherapy equipment to ensure good quality and safety compliance and performance.
(c) Spare parts should be widely and readily available for equipment. This is a major problem in third world countries, which rely on importation of equipment from abroad and technical assistance from donor agencies.
(d) There should be good training of local staff to make them self-reliant in the operation and maintenance of equipment.
(e) There is a need to set up a secondary standard Dosimetry Laboratory in the country to calibrate dosimeter, equipment used for radiotherapy equipment.
(f) Regional cooperation and exchange of facilities, equipment and experts between institutions is recommended.

References