H E A L T H

Technologies for Better Quality of Life

BRACHYTHERAPY

RADIATION THERAPY FOR CANCER TREATMENT

Human cells are basic units of living organisms. All tissues are made up of cells. Adult human body consists of about 10^{14} cells. Cells of different tissues have different sizes and shapes. All cells contain a central nucleus with the exception of red blood cells, which is surrounded by a viscous fluid called cytoplasm. The nucleus contains chromosomes, which constitute an array of genes. The chromosomes control all the functions of a cell and in turn the tissue. Cells originate or multiply from the existing cells by process of cell division. When radiation passes through the body, it transfers some of its energy to cells by means of ionization and excitations, which in turn lead to variety of chemical changes. Generally, these chemical changes cause harm to the cells. Depending on the seriousness of the harm a cell dies or gets modified.

Uncontrolled multiplication of cells leads to malignancy or cancer. This normally occurs in lymph nodes. There are many ways of treatment of cancer, including surgery, chemical therapy and radiation therapy. Radiation therapy uses the property of destroying the cells by focusing a beam of radiation on the cancerous cells. Many types of radiation therapy are possible.

Teletherapy: In teletherapy, the radiation is focused on the cancerous tissue from a distance. Cobalt-60 and Cesium-137 are the main isotopes used for treatment.

At present, Cobalt-60 is widely used for this method of treatment of cancer.

Brachytherapy: In brachytherapy, the radiation source is kept within the cancerous node or very near to its surface. Normally natural cavities of the human body are used for placing the radiation source inside the body. Cesium-137, Cobalt-60 and Iridium-192 are used for this type of treatment. Cobalt-60 having high gamma energy damages the surrounding tissues and hence its use is limited. Cs-137 sources loaded in the spring or Iridium-192 wire sealed in a plastic tube is used for brachytherapy.

BRIT is involved in manufacture of both teletherapy as well as brachytherapy sources in its Hot Cells at Trombay. Cobalt-60 sources are fabricated by doubly encapsulating the high specific activity Cobalt-60 pellets in stainless steel capsules using TIG welding process as per national and international standards. The high specific activity pellets with activity greater than 250 Ci/gm need to be imported. The activity is about 6000 Ci per unit. About 10-15 units are loaded with fresh activity of Cobalt-60 sources every year. Medium specific activity sources (130 RMM) are being planned with indigenously produced cobalt. Cesium-137 sources for Manual After Loading Applicator Kits are fabricated by encapsulating the 1.5 mm diameter and 5 mm length Cesium chloride incorporated in glass rod which in turn is put in stainless steel capsules and sealed using TIG welding. These sources are loaded in springs and are placed in the storage cum transport container. Each kit can be used for two patients. 50 kits are being used in the hospitals in the country. A laser welding system has been installed to improve the production of Cesium-137 sources. Iridium-192 platinum wire with about 1-5 Ci/cm of activity is used for the treatment of cancer. This wire with 0.3 mm diameter is supplied in lengths of 50 or 100 cm. The iridium wires are irradiated in the Dhruva reactor. Annually 60 metres of wire is used in various hospitals in the country. Work is going on for development of Iodine-125 sources for treatment of ocular and prostate cancers. The activity of the sources is 1.5 to 3 mCi for ocular cancer and 0.5 to 1 Ci for prostate implants. Titanium capsule with dimensions of 0.8 mm × 3 mm length are used for this purpose.

Manual After-loading System Applicator

A manual afterloading applicator has been fabricated by the Bhabha Atomic Research Centre in collaboration with the Tata Memorial Hospital, Mumbai. The design of the applicator is based on the recommendations of a National Committee constituted by Director, BARC to encourage use of afterloading techniques in radiation therapy centres in India.

The applicator is made of stainless steel and weighs 160 gm. The uterine tubes are available in different angles viz., 0°, 15°, 30° and 45°. The ovoid catheters make an angle of 30° with the horizontal plane. Thus the angle which the vaginal sources make with the plane of uterine sources vary from 30° to 75° depending on the angulation of the uterine tube. A small slit is made on the upper side of the angulated uterine tube which helps to position the tube accurately. Similar markings are made on the locking side of the ovoid catheters which help to position the ovoids symmetrically.

The source pencil assembly consists of a closely wound helical spring in which sources are held in position by a loosely wound spiral spring and a tight-fit cap. The number of rings on the cap indicates the number of sources within the pencil, e.g., 3 rings for the long uterine tandem.

The applicator is meant for use with Cs-137 tubes. However other sources whose dimensions do not exceed 3.05 mm diameter and 21 mm length may also be used.

The applicator is supplied along with the required Cesium-137 sources, a set of typical isodose charts and a storage-cum-transport container as a kit. Additional accessories and spare parts such as ovoids, stainless steel screws with nylon washers, source pencil caps, applicator caps, flange, allen key and a box for storing the applicator when not in use, are supplied with the applicator.

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