Future of ^{60}Co in the Treatment of Cancer

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INTRODUCTION

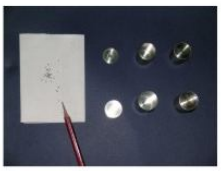
Treatment of cancer by using radiation emitted from the radio-isotopes is in practice for decades . Teletherapy and Brachytherapy are widely used for this purpose. In Teletherapy, the cancerous volume is irradiated by gamma rays emitted by radio-isotopes such as ^{60}Co for killing the cancerous cells by damaging the DNA .The challenge of radiation treatment is to deliver the large enough doses to the cancer cells while minimizing the dose to normal tissues. With the recent developments in imaging and in technology the metabolic or functional status of cancer cells, the position of tumour related to surrounding normal tissue can be more clearly delineated. Equipment based on linear accelerators and ^{60}Co are the work horse for the medical physicists and oncologists. With introduction of newer versions of ^{60}Co equipment like gamma knife, gyro knife with high dose to target to normal tissue ratio, the necessity of ^{60}Co in the treatment of cancer becoming more important. This paper discusses the merits and demerits of these methods and concludes that ^{60}Co remains as a requirement for the future.

^{60}CO TELETHERAPY MACHINES

Teletherapy machines machines using ^{60}Co are widely used f or the last forty years for the treatment of cancer. The recent introduction of BHABHATRON machines in India with state of art facilities is shown in the figure. These units are simple to operate, very reliable, does not require high technology. The disadvantages of these units are ,high penumbra, low percentage depth dose, high field size, dose rate decrease due to decay and safety and disposal of the decayed source These unit are easy to operate even in difficult conditions prevailing in the developing and under developed countries.







LINEAR ACCELERATORS

The disadvantages of the cobalt teletherapy units has overcome by the development of linear accelerators and its utilities. The linear accelerators are capable of producing nearly a continuous stream of particles. The precise and accurate electron beams are directed at a high density target to produce X-rays with varying energies. Even the electrons can treat the malignant tissues. Multileaf collimators can be used for the conformal radiotherapy. The advantages are high throughput at various energies, can be switched off when not required for radiation safety, adoptable to the new techniques such as IMRT and IGRT for 2D/3D conformal therapy. The disadvantages are require high technology, requires reliable power supply which remain erratic in under developed or in remote corners of developing countries. The capital cost is coming down to compete with the cobalt machines. The use of these machines is mainly in the advanced cities. However, in small countries where indigenous designs are available, the linear accelerators are still found to be expensive to buy , operate and maintain.

GAMMA KNIFE / GYRO KNIFE & SUPER GAMMA

The development of Gamma Knife using multiple precise gamma ray beams from multiple sources focused at the brain tumour gains advantage over the linear accelerators. Gammaknife uses high doses of radiation to kill cancer cells and shrink tumors, delivered with surgical precision to avoid damaging healthy brain tissue. Gamma knife radiosurgery is able to accurately focus many beams of high-intensity gamma radiation to converge on the tumour. Each individual beam is relatively low energy, so the radiation has little effect on intervening brain tissue. The low energy beams are focussed on the tumour from different directions hence in the tumour they create required dose. This allows non-invasive (without opening the skull) brain surgery with extreme precision and without injury to normal brain. In this the sources are fixed and is useful for brain tumours as per the design. In " Gyro knife" number of inclined sources focusing at a point housed in a body which can rotate about its axis and the body itself can revolve to access differently located tumours in the body keeping the target to skin ratio very high. In " super gamma" same effect is produced by having number of sources located offset to each other so that hen they rotate they focus at the same target but enter the body from different positions. The new generation equipment integrates head and body treatment into one and hence they can do both radiotherapy and radiosurgery.

DISCUSSION

The cobalt teletherapy units are capable of treating the various superficial , head and neck and breast tumours . The advantages for these units are less cost, simple to operate and can be used in the remote corners of the developing and under developed countries. The disadvantages of these are over come by the development of linear accelerators for deep seated tumors and for 2D/3D conformal radiotherapy including IMRT and IGRT. These linear accelerators are high cost, require high technology and highly skilled manpower. For the steorotactic brain surgery gamma knife, gyro knife and super gamma machines are more useful. Even the normal radiotherapy can be carried out in these machines in the new generation equipment

CONCLUSION

Lower initial cost of cobalt machines as compared to their equivalent LINACS, less dependency on power and other working conditions, use in gamma knife, gyro knife and super gamma for radiotherapy and surgery, the use of ^{60}Co machines is likely to remain for many more years to come particularly in under developed and developing countries of the world.