

Cancer treatment: A look at technological advancements

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Cancer is not only an important health problem in developed countries, but in a developing country like ours it is also a major health problem. It is going to be a bigger problem since it is predicted that there is going to be fivefold increase in the number of cancer patients in India by 2025. This is because of a change in our dietary habits, lifestyle, environmental pollution, and increasing life span. Surgery, Radiation, and Hormonal therapy are old but effective anticancer therapies.

Surgery which involves removal of primary tumor and associated regional lymph nodes cures more patients than any other individual form of cancer therapy because it works on zero order kinetics in which 100% excised cancer cells die. After the introduction of radiation oncology in 1920 and anticancer chemotherapy in 1940 shift has taken place from radical surgery to less radical/conservative surgery.

Radiotherapy and chemotherapy are capable of destroying only a fraction of cancer cells with each treatment and are thus complementary to each other. Considerable improvement in operative and anesthesia techniques has increased the 5-year survival rates in colorectal liver metastases. Radiotherapy is used in various cancers involving rectum, esophagus, breast etc., alone or in combination with surgery pre or post-operatively and or with chemotherapy. Chemotherapy may be used before, during or after radiation therapy. Hormones are being used with good response in breast and prostate cancer. Two-thirds of cancer patients have been able to defeat their disease by the use of these combined modalities of treatment mentioned above. With the advent of robotic surgery and gamma knife the results are improving further.

Immunotherapy: Cell based immunotherapy is used for prostate carcinoma, antibody-based as targeted therapy for colorectal cancer, cytokine-based Interleukin2 and Interleukin alpha in renal cell carcinoma and malignant melanoma.

Vaccination for prevention of cervix cancer by using HPV vaccination in girls between ages of 9-12 years is in practice in our country. Therapeutic vaccination against carcinoma prostate and melanoma is already approved by FDA.

Vitamin A and its synthetic derivatives have shown to have a protective effect against the development of a second cancer in the head and neck. It has also been shown to protect against the development of non-melanoma tumors in Xeroderma pigmentosa. Its use in the treatment of neuroblastoma and breast carcinoma is under trial.

Targeted therapy: For almost a century cytotoxic drugs have been in use but the problem with them has been life threatening levels of toxicity, if maximum tolerated dose is exceeded. It is well established that tumors need some factors for their growth and proliferation. Thus the targeted role of antiHER2 in Her-2 positive metastatic breast cancer has been established in improving progression free survival. Similarly, Anti-EGFR targeted therapy is used in EGFR plus colorectal tumors, metastatic or otherwise. Similar benefit has been found in Squamous cell carcinoma of oropharynx or larynx. Some inhibitors have been used for epigenetic therapy of cancer. Newer drugs have been tried to inhibit angiogenic vasculature so that tumor spread is inhibited as in case of metastatic colorectal cancer, renal cancer, and breast & central nervous system tumors. Delivery systems like use of nanoparticles both degradable and nondegradable are also under trial to improve response rate.

Virotherapy: Use of oncolytic viruses to grow in tumor cells is under trial. The viruses will target tumor cells destroying them at the same time spare normal cells.

Precision Medicine: It is now well understood that cancer is a disease of genome, more we learn about tumors, more we find that each tumor has its own set of genetic changes. Understanding them better will make it possible in future to tailor make the treatment of each cancer patient. One can envisage a future in which we will be able to cross-reference an individual's personal history and biology with patterns found worldwide and use the network of knowledge to pinpoint and deliver care that is preventive, targeted, timely and effective. This is what is referred to as precision medicine. Genomic information has already borne the fruits by development of drugs for breast and colon cancer. Many more drugs are likely to follow.