

Recent Cancer Therapies

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In the early part of 20th century extensive radical surgery for cancer was the norm. It leads to many side effects which needed to be addressed by newer modes of therapy.

The older days of radical mastectomy with its complication of lymphedema is being replaced by Breast conserving surgery with sentinel-node removal. This helps to improve the esthetic results and avoid the side effects [1].

Chemotherapy, surgery and radiotherapy in combination are being used for treatment of various cancers from many years. Chemotherapy the term which was coined by Germany scientist Paul Ehrlich was started in early 20th Century.

Surgery and Radiotherapy were the basis of solid tumor treatment in the 1960.

Surgery was started as the first radical mastectomy performed in 1890 by Halsted. This is slowly being replaced by use of non-invasive surgeries like Laparoscopic colectomy, video thoracoscopy, radio frequency ablation and radio surgery techniques like cybercafé [2].

Radiology and Radiotherapy was introduced by Becquerel and Roentgen in the late 19th century with Marie Curies work helping in the development of radiotherapy.

Radiotherapy has advanced from rotational Linac radiotherapy to three dimensional X-Ray therapy to latest advance in scanning technique of video sequence of tumour movement [3].

The other methods are combined system called as radiogenic therapy which induces the formation of cytotoxic agents against cancer cells.

Another modality consists of radiolabeled molecular which fight cancer by delivering targeted radiation to receptor bearing cells.

There are other recent modes of therapy developed to overcome the limitation of the previous therapy methods.

Immuno therapy

The concept of immunotherapy was to use the component of the immune system such as antibodies, cytokines and dendritic cells to treat cancers as they often show much more specificity, higher efficacy, directed therapy, less toxicity lower secondary effects and better tolerance.

Their capacity is to either kill tumour cells (either directly or indirectly) or help the patients' immune system to destroy tumour.

There are many Types of immunotherapy that are used to treat cancer. Types of immunotherapy that help the immune system act, directly against the cancer include checkpoint inhibitors which are drugs that help the immune system respond more strongly to a tumour. They interfere with the ability of cancer cells to avoid immune system attack [4,5].

Indirect type of immunotherapy.

Adoptive cell transfer which is a treatment that attempts to boost the natural ability of T cells are taken from the patient, grown for 2 to 8 weeks, given back to the patient who has received chemotherapy and radiation therapy.

Another method is by production of Monoclonal antibodies which are proteins produced in the laboratory designed to attach to specific targets found on cancer cells.

Cell based immunotherapy is a method where Natural killer cells and cytotoxic T-lymphocytes (CTL) are used to attack and attach to the cancer cells along with other modes of treatment called as Autologous Immune Enhancement Therapy (AIET) [6,7].

Cancer vaccine which works against cancer by boosting the immune response to cancer cells esp. in malignant melanoma and renal cell carcinoma.

Haematopoietic stem cell transplantation wherein the donor's immune cells will attack the tumor as a graft versus tumor effect leading to higher cure rate, but has more severe side effects.

Type of immunotherapy that enhances the body's immune response to fight the cancer includes cytokines like interferons and interleukins which induce immune response in Renal cell carcinoma and Melanoma patients.

Another e.g. is BCG for treatment of Bladder cancer. It is being studied in other types of cancer [8].

Immunotherapy can cause side effects like pain swelling, soreness, Redness and flu like symptoms allergic reactions. Immunotherapy can be given in form of I.V, I.M, and combination with chemotherapy.

Nano based therapies

Compared to the traditional modes of treatment of chemotherapy, radiation and surgery, recent modes of therapy have been included which use Nano scale and Nano structure materials to aid cancer treatment. These modes of treatment have an advantage of their ability to target tumors (actively or passively) to respond to physical or chemical stimulation (internal or external) and which can deliver the therapy to the target cancer cell [9].

There are therapies like targeted therapy hyperthermia photodynamic and gene therapies which use engineered Nano materials for cancer treatment.

These will be briefly written about.

Targeted cancer therapies

Nano particles are engineered to achieve cell targeting by using selective moieties like egg. antibodies, folic acid which will bind to their specific receptor like antigen once the moiety reaches its tar-

get the cargo is released into the interior of the cancer cell and ideally a signaling marker attached to the vector can be traced by color or fluorescence and thus help the oncologist to visualize the tumor.

Eg. is folic acid which is over expressed in a broad range of tumour cell types including solid and haematological malignancies [10].

Photodynamic therapy

It is a methodology wherein the photosensitizer is activated upon exposure to visible or near infrared (NIR) light. It activates by generating reactive oxygen species like formation of free radicals which induce cell death by oxidation process of cellular proteins lipids and amino acids. It is used in combination with the traditional methods of therapy [11].

Hyperthermia

Here the principal used to kill cancer cells is a process called thermal ablation. The process involves increasing the temperature to above 430 wherein the heat causes irreparable damage to the cancer cell which can be destroyed further easily by either radiation chemotherapy.

It makes use of microwaves ultrasounds and radio frequencies which can be focused only on the tumour without damaging the surrounding normal tissue [12].

Gene therapy

This process involves the use of DNA, RNA, small interfering RNA and antisense oligonucleotides into specific target cells or tissue to restore and to eradicate any pathology in the genes of the cells.

It is a complex process which includes methods to normalize mutated genes, inactivate oncogenes expressing suicide genes and eliciting protective immune responses [13].

Personalized medicine

As it is found that different patients respond in different ways to a given therapeutic agent advances are being made to go for personalized medicine by studying individual genetic make up.

This is being achieved by using genomic and proteomic technologies which are quickly evolving to detect specific molecular targets in patient tumour samples.

The future is the use of viral and non-viral vectors tailored to meet patient specific tumor characteristics [14].

Advantages of Nano particles are that.

1. They can be synthesized to specific size with surface characteristics to penetrate tumour cells by taking advantage of enhanced permeation and retention effect (passive targeting) to active targeting wherein nanoparticles can be engineered to target tumours cells.
2. They can be engineered to penetrate cells and physiological barriers increase the plasma half life of chemotherapeutic Drugs and protect the drugs from biological degradation and help in effective treatment
3. They can be synthesized as multifunctional platforms for combining imaging and therapeutic applications [15].

Other treatment modalities are angiogenesis inhibitors therapy, biological therapies like interferon, vaccines, laser therapy. Other methods to support cancer treatment are,

- Alternative medicine
- Holistic medicine
- Pain case therapy

All the modalities try to reduce pain the side effects of cancer therapy improve immune response to survivors. One example is yoga therapy for fresh and survivors of breast cancer an alternative medicine which is known to give a better immunity to the patient. Thus they can respond better to chemotherapy or radiotherapy.

Conclusion

Cancer has become a major cause of concern both in the high and low income group countries. It definitely has improved with the latest modalities or treatment, but still has its limitation.

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