organ or tissue. Radiotherapy can provide high curative rates in cancers such as Hodgkin's disease and testicular cancer. While being absorbed by the cells, radiation causes random injury to the DNA. Efficacy is determined by the extent of cellular damage that is beyond repair. In general, cell killing is achieved when the normal cells are more effective in repairing themselves, causing more death in the cancer cell population. The dose of radiation is quantified as the amount of energy absorbed per unit mass and the standard unit is the gray (Gy), which is defined as one joule per kilogram. When delivered to a tumor, the dose of radiation is limited to the damage to the surrounding healthy cells. It is also dependent on several factors such as the goal of the therapy (curative versus palliative), relative sensitivity of the specific cancer cells to radiation, the volume of cancer, and condition of the patient.

SEE ALSO: Breast Cancer; Cancer (General); Cancer Chemotherapy; Chemotherapy; Colorectal Cancer; Nausea and Vomiting; Oncology.

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Chemotherapy

Chemotherapy is the treatment of disease by administering drugs. Chemotherapy is most commonly used to treat all types of cancer by destroying cancer cells and preventing them from metastasizing. During chemotherapy, chemicals are introduced into the body to destroy cancerous cells and tumors, and these chemicals also spread throughout the body, destroying malignant cells that have spread to other organs. Chemotherapy works well, but it also affects normal cells, causing undesirable side effects.

Chemotherapy disrupts the cell cycle, which is the process by which cells reproduce, grow, and perform their daily functions. If the cell cycle is disrupted, the cell dies. Chemotherapy drugs may disrupt a specific phase of the cell cycle, usually the DNA replication phase. This means that chemotherapy drugs also disrupt cell cycles in normal body cells such as in the bone marrow, the mouth, and the digestive track, causing unpleasant side effects such as hair loss, mouth sores, vomiting and nausea, and a weakened immune system if drugs affect the bone marrow. Extra medication is taken to counter these side effects. The countermedications help restore the normal functioning of the stomach and prevent nausea and vomiting. White blood cell count is also carefully monitored by physicians administering chemotherapy drugs to patients.

Different types of chemotherapy drugs exist to treat various types of cancers and tumors, and they affect these cells in different phases of the growth cycle. For example, alkylating drugs disrupt cells in all phases of the cell cycle and are commonly used to treat lymphatic cancers, skin cancers, and other malignancies. Alkylating drugs work by adding alkyl groups to electronegative regions of all cells, causing adjacent guanine bases in DNA to attach to each other and disrupting DNA replication in the S phase of the cell cycle. An example of an alkylating drug is cyclophosphamide, which also attacks the immune system.

Other types of alkylating drugs include nitrosoureas, which inhibit the DNA repair phase. Nitrosoureas can also flow through the blood-brain barrier and are used in the treatment of brain malignancies. Common nitrosoureas are carmustine (BCNU), semustine, and lomustine (CCNU). Other types of chemotherapy drugs are antimetabolites, which mimic DNA substrates. This causes the incorrect substrate (an antimetabolite) to be inserted into a growing DNA strand, creating abnormal DNA. An example of antimetabolites is flucytosine. Mitotic inhibitors, another type of chemotherapy drug, work by attaching to a protein called tubulin, thus preventing cell division. Finally, there are drugs that change the levels of sex hormones produced in the body. For example, estrogen is needed by some ovarian and breast cancers to grow. These drugs lower the level of body estrogen, thus preventing the spread of cancer.

Chemotherapy drugs are most commonly administered using combination therapy. During combination therapy, two different drugs are prescribed at the same time in smaller doses, thus reducing the occurrence of side effects. The two drugs work effectively by attacking cells in different phases of growth, making the attack more powerful and effective. Combination therapy also reduces the risk of developing resistance to chemotherapy drugs, which can develop with prolonged use of a particular drug.

Chemotherapy also works in combination with surgery and radiation therapy. Chemotherapy drugs may increase the effectiveness of radiation therapy, thus reducing the dosage of radiation needed for treatment. Surgery may also make chemotherapy drugs more effective. Tumors may be surgically removed and then drugs may be administered in lower dosages to attack only the area surrounding where the tumor had been. Drugs may be administered in the form of a pill or injected into the body using a needle. Chemotherapy is administered in highly variable periods of treatments, giving the body ample time to recover and rest. Some patients may be given daily treatments, some once a month, and others once every three weeks.

Chemotherapy is not always successful—not even in combination with radiation therapy and surgery. Some cancers and tumors of the brain, pancreas, and prostate do not respond to these chemical treatments. Doctors have come up with new compounds that locate cancer cells and shut them down while allowing healthy cells to function normally. An example of such a drug is Gleevec®, used for treating chronic myelogenous leukemia. Further research is being conducted in the field of biomedical engineering, where miniature machines pinpoint malignant cells and perform microsurgery—safely removing all infected cells without damaging normal cells and without side effects.

SEE ALSO: Cancer (General); Cancer Chemotherapy; Cancer Radiation Therapy; Chemoradiotherapy.

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Zhong Wei Chen was a Chinese microsurgeon and orthopedic surgeon who became a leader in his field when he became the first to perform and publish a report of a hand reattachment in 1963. After this successful operation, Chen developed many other microsurgery procedures while working at the Sixth People's Hospital in Shanghai, China.

Chen was born in Ningbo, Zhejiang Province, China, in 1929, the son of a doctor and a pharmacist. In 1948, he entered the Shanghai Second Medical College, where he developed his interest in surgery. He enrolled in postgraduate training in 1954 at