



A Study On Types Of Chemotherapy In Cancer

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ABSTRACT:

Cancer is the second most common cause of death in US accounting for 1 in 4 death. Cancer is a condition in which some of the body cells uncontrollably grow and spread all over the body. It can start anywhere in the body. Generally, chemotherapy along with the cancer agents are used to reduce the growth of malignant cells. This therapy may be used to cure and produce palliative relief to patient and increase the quality of patient life. The importance of chemotherapy for cure of cancer is increasing especially with its use as adjuvants to local therapy. Cancer is treated by different types of chemotherapies, radiation and surgery. General terms are: benign and malignant. Whereas the benign are non-cancerous tumors and malignant s are cancerous tumors.

Key words: chemotherapy, cancer treatment, pharmacology, oncology, benign, malignant , antineoplastic therapy.

INTRODUCTION:

CHEMOTHERAPY:

Chemotherapy is a common cancer treatment. It uses drugs to destroy cancer cells and prevent tumor growth. It may be paired with other cancer treatments such as radiation therapy or surgery. Chemotherapy is usually given intravenously (through a vein). It's an effective treatment but can cause side effects. Chemotherapy is the treatment of infectious diseases or malignancy with drugs which destroy microorganisms or cancer cells preferentially with minimal damage to host tissues. The infection may be due to bacteria, virus, fungi, protozoa or helminths.

Chemotherapy is the science that deals with the treatment of disease by means of chemicals (chemotherapeutic agents) that have a specific toxic effect upon the disease-producing microorganisms or that selectively destroy cancerous tissue.

CANCER:

Cancer is a large group of diseases that can start in almost any organ or tissue of the body when abnormal cells grow uncontrollably, go beyond their usual boundaries to invade adjoining parts of the body and/or spread to other organs. The latter process is called metastasizing and is a major cause of death from cancer. A neoplasm and malignant tumor are other common names for cancer.

TYPES OF CANCER: There are more than 200 types of cancer and we can classify cancers according to where they start in the body, such as breast cancer or lung cancer. We can also group cancer according to the type of cell they start in. There are 5 main groups. These are:

carcinoma – this cancer begins in the skin or in tissues that line or cover internal organs. There are different subtypes, including adenocarcinoma, basal cell carcinoma, squamous cell carcinoma and transitional cell carcinoma.

sarcoma – this cancer begins in the connective or supportive tissues such as bone, cartilage, fat, muscle or blood vessels.

leukemia – this is cancer of the white blood cells. It starts in the tissues that make blood cells such as the bone marrow.

lymphoma and myeloma – these cancers begin in the cells of the immune system Open a glossary item.

brain and spinal cord cancers – these are known as central nervous system cancers.

Chemotherapy is a type of cancer treatment. Also called "chemo," it's one of several cancer treatments that use drugs against various types of cancer. Other drug therapies include:

Hormone therapy: Drugs that prevent certain cancers from getting the hormones they need to grow.

Immune therapy: Drugs that help your immune system fight cancer.

Targeted therapy: Drugs that change how cancer cells multiply and behave.

Chemotherapy may get used with surgery or radiation therapy to treat cancer.

PURPOSE OF CHEMOTHERAPY:

1. To Decreased Size of tumor.
2. To Control Sign & Symptoms.
3. To Maintain the Patient good Mental Status.

Some cancers don't respond well to systemic chemotherapy. In certain cases, might need chemotherapy delivered to a specific area of the body. Examples include:

Intra-arterial chemotherapy: Goes into a single artery that supplies blood to a tumor.

Intracavitary chemotherapy: Goes directly into a body cavity, such as bladder or belly. One form is hyperthermia intraperitoneal chemotherapy (HIPEC). It puts heated chemotherapy in abdomen after surgery.

Intrathecal chemotherapy: Goes into the area between your brain and spinal cord.

CHEMOTHERAPY FOR CONDITIONS OTHER THAN CANCER:

Some chemotherapy drugs have proved useful in treating other conditions, such as:

Bone marrow diseases: Diseases that affect the bone marrow and blood cells may be treated with a bone marrow transplant, also known as a stem cell transplant. Chemotherapy is often used to prepare for a bone marrow transplant.

Immune system disorders: Lower doses of chemotherapy drugs can help control an overactive immune system in certain diseases, such as lupus and rheumatoid arthritis.

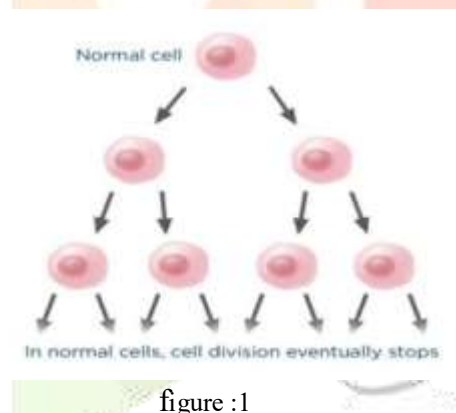
HOW DOES CHEMOTHERAPY WORKS: Chemotherapy drugs work in a few different ways. They can:

1. Kill both cancerous and healthy cells
2. Fight only cancer cells
3. Keep tumors from growing blood vessels, which help them thrive
4. Attack the cancer cells' genes so the cells die and can't grow into new tumors.

Our bodies are composed of trillions of individual cells, the "building blocks" of life. These cells-of which there are many types serving different functions in the body-have a natural life cycle. Cells that die or are old or damaged are replaced by new cells, through a process by which a living cell duplicates its contents and then divides to form two identical cells. Specifically, within each cell is the nucleus, which is comparable to the "brain" of the cell. The nucleus contains chromosomes, which are made up of genes. Genes, in turn, are made up of DNA, the instructions within a cell that control how the cell grows in a systematic and precise way. Once a cell copies its genes, it divides, forming two new cells, each with its own complete set of genes.

Healthy, normal cells in the body grow and divide in an orderly manner, per the instructions encoded in the genes, to replace dead, old, or damaged cells.

HOW NORMAL CELLS GROW AND DIVIDE:



When a gene has an alteration in its DNA code of instructions, it is said to be "mutated." Mutations occur often, and normally the body can correct them. The correction method is similar to a "spell check" function on a computer or cell phone. However, sometimes, the "spell check" function does not work as it should, and the DNA mutation may become part of the cell's blueprint. Over time, an accumulation of mutations can cause cells to lose the capacity to grow and divide in an orderly manner. Out-of-control growth may occur instead, which can lead to the formation of a tumor.

HOW CANCER CELLS GROW AND DIVIDE :

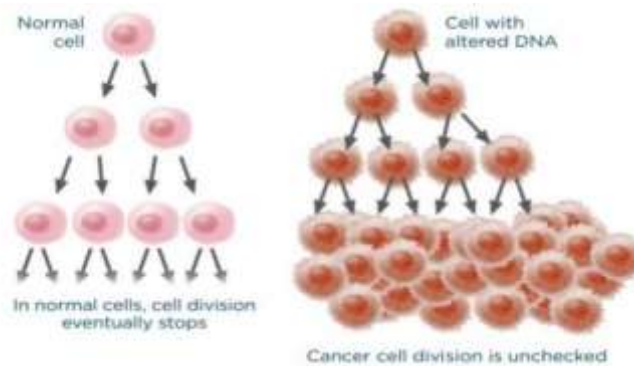


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HOW CHEMOTHERAPY WORKS :

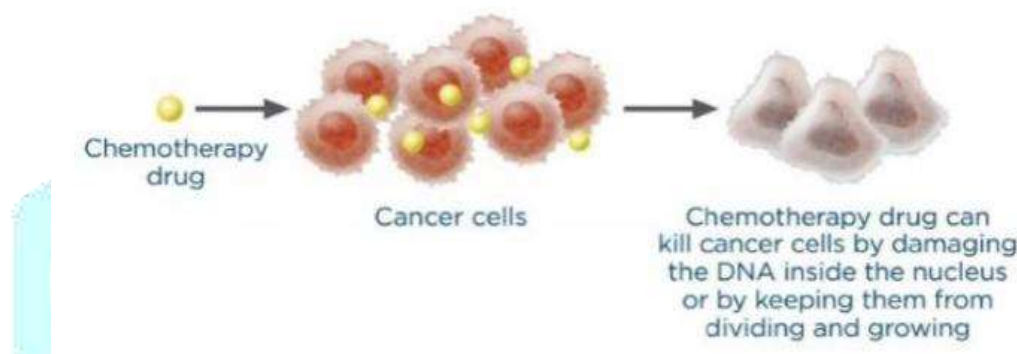


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Chemotherapy drugs work by damaging the DNA inside the nucleus of rapidly growing cells or by keeping the cells from dividing and growing. This may happen either when a cancer cell is making copies of its genes or when the cancer cell is about to divide.

CHEMOTHERAPY TREATMENT:

- Chemotherapy regimens are aimed at destroying rapidly growing cancer cells with cytotoxic substances.
- Cancer cells depend on the same mechanisms for cell division that are found in normal cells. Damage to those mechanisms leads to cell death
- Curative chemotherapy aims to increase survival outcomes & palliative chemotherapy provides symptomatic relief for terminal cancer patients.
- Combination chemotherapy is accompanied by radiotherapy, surgery or other anticancer drugs.
- Chemotherapy is administrated in cycles of treatment. Patients are infused with drugs at regular intervals.
- Routes of administration for chemotherapy are oral route, intravenous route, intravascular route, subcutaneous route etc.

TYPES OF CHEMOTHERAPY:

- a. Primary chemotherapy
- b. Adjuvant chemotherapy
- c. Neo adjuvant chemotherapy
- d. Concurrent chemotherapy

PRIMARY CHEMOTHERAPY:

Chemotherapy is main modality of treatment. Can be single drug or combination chemotherapy.

e.g. Hematological malignancy.

Adriamycin Bleomycin Vinblastine Dacarbazine regimen for Hodgkins's lymphoma.

Primary chemotherapy of breast cancer refers to the use of chemotherapy before definitive local treatment. Other synonymous terms include preoperative chemotherapy, neoadjuvant chemotherapy, induction chemotherapy, and upfront chemotherapy. Beginning in the early 1970s, primary chemotherapy has been explored to improve local control and survival in women with large breast tumors or inflammatory breast cancer.

Primary chemotherapy produced regression of breast cancer in 60-90% of women and made a significant impact on survival in inflammatory and locally advanced disease. Although primary chemotherapy was incorporated into standard treatment algorithms for select tumors such as Ewing's sarcoma, and carcinomas, and locally advanced and inflammatory breast cancer, its role in the treatment of resectable breast cancer is undefined.

ADJUVANT CHEMOTHERAPY:

Combined with radiation or surgery.

Refers to the treatment given after surgical removal of a tumor.

e.g. breast CA after surgery to remove microscopic foci.

In this chemotherapy after decreased the size of tumor. Apply or using a radiation therapy.

Adjuvant chemotherapy – also called preventive chemotherapy – is a cancer treatment may get after surgery, radiation, or other main treatments to destroy any leftover cancer cells. The goal is to prevent the cancer from coming back.

TYPES OF ADJUVANT CHEMOTHERAPY:

The adjuvant chemotherapy drugs get depend on type of cancer. Examples of these medicines include:

- 5-fluorouracil (5-FU) stops cancer cells from fixing their own DNA.
- Anthracyclines such as doxorubicin (Adriamycin) and epirubicin(Ellence) damage the DNA in cancer cells.
- Carboplatin (Para platin) has the metal platinum in it, which slows or stops cancer cells from dividing.
- Cyclophosphamide (Cytoxan) slows the growth of cancer cells.
- Taxanes like docetaxel (Taxotere) and paclitaxel (Taxol) stop cancer cells from dividing.

TYPES OF CANCER TREATED WITH ADJUVANT CHEMOTHERAPY:

Doctors use adjuvant chemotherapy to treat:

BREAST CANCER: Breast cancer is a disease in which abnormal breast cells grow out of control and form tumors. If left unchecked, the tumors can spread throughout the body and become fatal. Invasive cancers can spread to nearby lymph nodes or other organs (metastasize). Metastasis can be life-threatening and fatal. Treatment is based on the person, the type of cancer and its spread. Treatment combines surgery, radiation therapy and medications. They might get chemotherapy after surgery to lower the chance that cancer will come back.

HOW TO IDENTIFY BREAST TUMORS:

- Pay attention to any new lumps or thickening of skin on breast or under arms.
- Even the size of lump is pebble can be caused for concern.
- You may also feel a small hardened area under the skin.
- Particularly if these changes happen on one side but not the other.
- And tell the doctor if notice change in the look feel of the skin or breast like dimpled or puckered skin, redness or a scaly texture or general inflammation.

TREATMENT FOR BREAST CANCER:

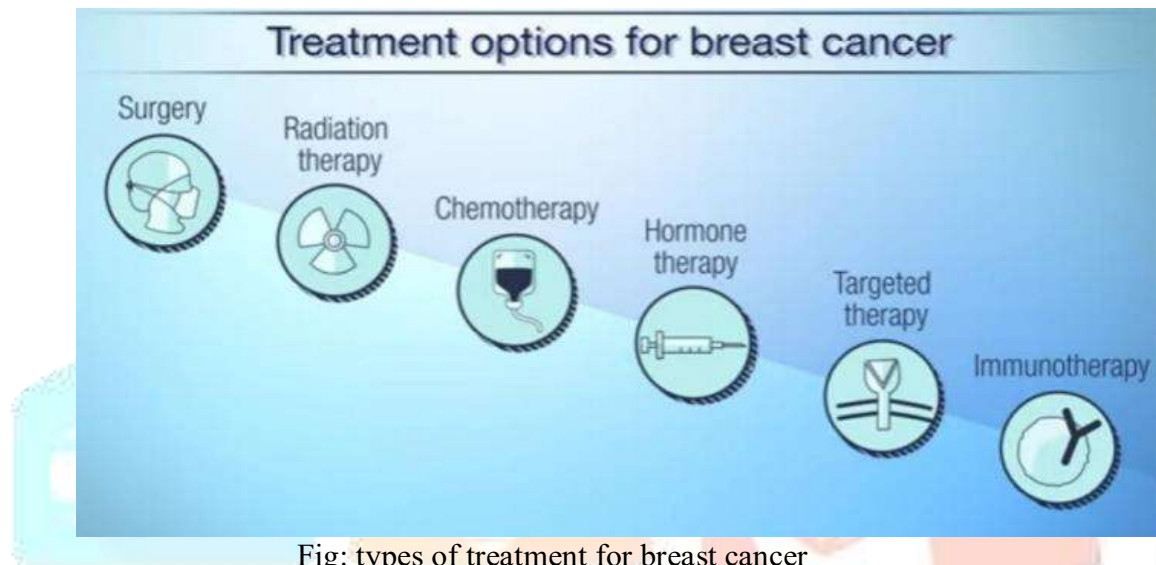


Fig: types of treatment for breast cancer

COLORECTAL CANCER: Colorectal cancer (CRC), also known as bowel cancer, colon cancer, or rectal cancer, is the development of cancer from colon or rectum (parts of large intestine). Signs and symptoms may include blood in stool, change in bowel movements, weight loss, abdominal pain and fatigue. It typically starts as a benign tumor, often in the form of a polyp, which over time becomes cancerous.

TREATMENT FOR COLORECTAL CANCER:



Fig : 2 types of treatment for colorectal cancer

RISK OF ADJUVANT CHEMOTHERAPY:

Chemotherapy targets quickly dividing cells. Cancer cells divide quickly, but so do healthy cells like hair and immune cells. When chemo damages healthy cells, it can cause side effects. Each type of chemotherapy has its own possible long- and short-term risks. Some common chemotherapy side effects are:

- Tiredness
- Hair loss
- Mouth sores
- Nausea and vomiting
- Diarrhea or constipation
- Infections
- Nerve problems like numbness or tingling

NEOADJUVANT CHEMOTHERAPY:

Neoadjuvant chemotherapy is medicine that treats cancer before it has a chance to grow, or shrinks the tumor before surgery so it's easier to remove. Unlike adjuvant chemotherapy, which get after another treatment, neoadjuvant chemo comes before surgery or another treatment so that surgery isn't so extensive.

Chemotherapy is given before surgery.

Shrink a large cancerous tumor to make surgery easy.

e.g. laryngeal carcinoma before surgery.

In this Chemotherapy only decreased the size of tumor.

TYPES OF NEOADJUVANT CHEMOTHERAPY:

The type of neoadjuvant chemotherapy drugs get depends on which cancer they have. Some of the same chemotherapy drugs that doctors use for adjuvant treatment are also part of neoadjuvant treatment.

Examples of neoadjuvant chemotherapy drugs include:

- 5-FU
- Anthracyclines such as doxorubicin (Adriamycin)
- Cisplatin
- Cytosan
- Epirubicin (Ellence)
- Methotrexate (Rheumatrex, Trexall)
- Taxanes

TYPES OF CANCER TREATED WITH NEO ADJUVANT CHEMOTHERAPY:

Doctors use neoadjuvant chemotherapy to treat:

BREAST CANCER: It can shrink the tumor so they can have a less invasive lumpectomy instead of a mastectomy. Or it can shrink the lymph nodes to make them easier to remove.

BLADDER CANCER: Chemotherapy shrinks the tumor to make it easier to remove during surgery. It may also lower the chance that the cancer will come back after surgery.

LARYNGEAL CANCER: They can get chemotherapy to make the tumor in your larynx (voice box) smaller. If the cancer shrinks enough, they may be able to get radiation instead of surgery.

OVARIAN CANCER: Neoadjuvant chemotherapy is a treatment for late-stage ovarian cancer. They might get it before surgery.

RECTAL CANCER: You may get chemotherapy before surgery to shrink the tumor and make it easier to remove.

RISK OF NEOADJUVANT CHEMOTHERAPY:

Chemotherapy medicines get before surgery or radiation can cause side effects like these:

- Nausea and vomiting
- Hair loss
- Infections
- Tiredness
- Bleeding
- Muscle and joint pain
- Numbness and tingling
- Diarrhea or constipation

CONCURRENT CHEMOTHERAPY:

Simultaneously with radiation.

Mainly act as radiation sensitizer, encourages the cancer cells to take radiotherapy.

e.g. Head and neck CA, rectal CA, lung CA.

Concurrent chemo-radiation uses radiotherapy and chemotherapy at the same time to treat cancer. Radiotherapy is a common form of anti-cancer treatment that beams high-energy radiation particles directly onto cancer cells.

TYPES OF CONCURRENT CHEMOTHERAPY:

1. Chemoradiation (CRT): Chemotherapy and radiation therapy given together.
2. Concurrent Chemoradiotherapy (CCRT): Chemotherapy and radiation therapy started simultaneously.
3. Sequential Chemoradiotherapy: Chemotherapy followed by radiation therapy.

CANCER TREATED WITH CCRT:

1. Head and neck cancer
2. Cervical cancer
3. Lung cancer
4. Colorectal cancer
5. Esophageal cancer

6. Pancreatic cancer
7. Breast cancer
8. Ovarian cancer

BENEFITS OF CCRT:

1. Improved local control and tumor response.
2. Enhanced survival rates.
3. Reduced treatment duration.
4. Increased efficacy in certain cancer types (e.g., head and neck, cervical, and lung cancers).

POTENTIAL SIDE EFFECTS:

1. Increased toxicity.
2. Enhanced radiation-induced side effects.
3. Higher risk of complications (e.g., pneumonitis, esophagitis).

CLASSES OF CHEMOTHERAPY DRUGS:

- Alkylating agents
- Antimetabolites
- Anti-tumor antibiotics (including anthracyclines)
- Plant alkaloids
- Topoisomerase inhibitors
- Vinca alkaloids
- Taxane

ALKYLATING AGENTS:

These compounds produce highly reactive carbonium ion intermediates which transfer alkyl groups to cellular macromolecules by forming covalent bonds. The position 7 of guanine residues in DNA is especially susceptible, but other molecular sites are also involved. They may react with carboxyl, hydroxyl, amino, sulfhydryl and phosphate groups of biomacromolecules.

Selected alkylating agents include: Altretamine, Busulfan, Carboplatin, Chlorambucil, Cisplatin, Cyclophosphamide, Dacarbazine, Mechlorethamine.

ANTI METABOLITES:

These are analogues related to the normal components of DNA or of coenzymes involved in nucleic acid synthesis. They competitively inhibit utilization of the normal substrate or get themselves incorporated forming dysfunctional macromolecules.

Some of the antimetabolites include: 5-fluorouracil, 6-mercaptopurine, Azacitidine, Capecitabine, Cladribine, Clofarabine.

ANTI TOMOUR ANTIBIOTICS:

Antitumor antibiotics prevent the DNA inside cancer cells from copying itself. Sometimes, they damage the cell's DNA. Anthracyclines are a specific type of antitumor antibiotic.

Selected anthracyclines include: Daunorubicin, Doxorubicin, Doxorubicin liposomal, Epirubicin, Idarubicin, Mitoxantrone, Valrubicin.

Other antitumor antibiotics include: Bleomycin, Dactinomycin, Mitomycin-C.

PLANT ALKALOIDS:

Mitotic inhibitors are also called plant alkaloids because they're made of the same material plants use to protect against predators. These drugs work by interfering with a cancer cell's ability to divide and make new cells, a process called mitosis.

Selected mitotic inhibitors include: Cabazitaxel, Docetaxel, Nab-paclitaxel, Paclitaxel, Vinblastine, Vincristine, Vincristine liposomal, Vinorelbine.

TOPOISOMERASE-2 INHIBITOR:

Etoposide: It is a semisynthetic derivative of podophyllotoxin, a plant glycoside. It is not a mitotic inhibitor, but arrests cells in the G2 phase and causes DNA breaks by affecting DNA topoisomerase-2 function. While the cleaving of double stranded DNA is not interfered, the subsequent resealing of the strand is prevented.

Etoposide is used in testicular tumors, lung cancer, Hodgkin's and other lymphomas, carcinoma bladder and stomach. Alopecia, leucopenia and g.i.t. disturbances are the main toxicity. Oral bioavailability is 50%; oral dose is double than i.e. dose.

VINCA ALKALOIDS:

These are mitotic inhibitors, bind to microtubular protein 'tubulin', prevent its polymerization and assembly of microtubules, cause disruption of mitotic spindle and interfere with cytoskeletal function. The chromosomes fail to move apart during mitosis: metaphase arrest occurs. They are cell cycle specific and act in the mitotic phase. Vincristine and vinblastine, though closely related chemically, have different spectrum of antitumor activity and toxicity.

Vincristine: (Oncovin) It is a rapidly acting drug, very useful for inducing remission in childhood acute lymphoblastic leukemia, but is not good for maintenance therapy. Other indications are acute myeloid leukemia, Hodgkin's disease, Wilms' tumor, Ewing's sarcoma, neuroblastoma and carcinoma lung.

Vinblastine: It is primarily employed along with other drugs in Hodgkin's disease, Kaposi sarcoma, neuroblastoma, non-Hodgkin's lymphoma, breast and testicular carcinoma. Bone marrow depression is more prominent, while neurotoxicity and alopecia are less marked than with vincristine. SIADH has been noted. It can cause local tissue necrosis if extravasation occurs during i.v. infusion.

TAXANES:

Since 1984, when paclitaxel was approved by the FDA for the treatment of advanced ovarian carcinoma, taxane have been widely used as microtubule targeting antitumor agents. However, their historic classification as antimetabolic does not describe all their functions. Indeed, taxane act in a complex manner, altering multiple cellular oncogenic processes including mitosis, angiogenesis, apoptosis, inflammatory response, and ROS production. (Reactive oxygen species).

Taxanes are a class of chemotherapy drugs providers use to treat ovarian cancer, breast cancer and prostate cancer, among other cancer types. They prevent cell division, or mitosis, the process cancer cells use to make more cancer cells. They kill cancer cells and slow tumor growth.

taxanes include: paclitaxel, docetaxel, Cabazitaxel.

CHEMOTHERAPY SIDE EFFECTS AND DRUG RESISTANCE:

According to WHO classification, chemotherapy is interconnected with several side effects that include immediate signs of toxicity and late signs of chronic toxicity starting from mild, moderate, severe or life threatening. The immediate effects of chemotherapy can be noticed from the skin and hair, bone marrow and blood, kidney. All-important organs of the body such as heart, lungs and brain could also be affected. Additionally, the severe and life-threatening neurotoxicity level can cause paralysis, ataxia, coma, spasm whereas the chronic effects of chemotherapy treatment include carcinogenicity, drug resistance, and infertility.

It revealed that the highest reported side effects were weakness (95%), fatigue (90%), nausea (77%), hair loss (76%) and vomiting (75%). There were also less occurring side effects which include mouth sores, diarrhea, dry mouth, abdominal cramps, memory impairment and numbness. Indeed, nausea and vomiting are among the most common side effects. Other than that, it was reported that 90% failures in chemotherapy during the invasion and metastasis of cancers are due to the drug resistance. Drug resistance in cancer cells results in decrease drug activity which enhance tumor insensitivity to the initial treatment or increase tumor resistance during or after treatment.

Table 1:some commonly used anti cancer drugs with side effects

Cancer type	Type/ class of chemotherapy drugs	Side effects
Non-Hodgkins lymphomas, multiple myeloma, breast cancers	Doxorubicin	Heart damage, soles of the feet, swelling & pain, skin eruptions on palms of the hand
Ovary, head, neck and lung cancers	Carboplatin	Decrease in blood cell count, hair loss, nausea, vomiting, confusion, diarrhea
Lymphoma cancer	Dacarbazine	Myelosuppression, vomiting, perivascular irritation
Metastatic breast cancer	Docetaxel with capecitabine (DX)	Nausea, discomfort, asthenia, neutropenia, diarrhea.
Breast, ovary, lung cancer	Paclitaxel	Allergic reaction, thin or brittle hair, joint pain, numbness or tingling in fingers or toes, decrease in blood cell count.
Ovary, pancreas, lung and breast cancer	Gemcitabine	Bleeding gums, diarrhea, loss of appetite, chest pain and joint pain.

CONCLUSION:

It can be concluded that chemotherapeutic drugs can be used in targeting different stages of cell cycle, disrupting DNA and RNA synthesis, preventing DNA damage repair and so forth. However, some of these expected outcomes may not be attained due to the several mechanisms of drug resistance that promote survival of cancer cells following chemotherapy. Despite of these side effects and drug resistance, chemotherapy remains methods of choice for cancer treatments.

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