

# New Connections

HELPING YOU FIND YOUR WAY THROUGH TREATMENT



Issue 14



## Chemotherapy: What does the term really mean?

To medical professionals, the word chemotherapy refers to *any* drug – even aspirin or penicillin – used to treat people with *any* disease. But to the average person on the street, chemo, as it's commonly known, refers specifically to cancer drugs.

The word cancer is similar in that it is a general term used to group together many different diseases that share one common feature: cells that begin to divide quickly and grow out of control. In the same way, the term chemotherapy is applied to hundreds of different drugs that share one common pharmaceutical purpose: to exploit the fact that cancer cells divide rapidly.

Chemotherapy drugs are a type of *systemic treatment* – that is, a drug that travels through the body and affects the entire system. By operating throughout the body, chemotherapy has the potential to reach and kill cancer cells that may have spread from their original location, which is one of the reasons chemotherapy is often the first choice of treatment for many cancers.

Radiation and surgical treatments, on the other hand, are targeted to specific, well-defined areas of the body, such as a breast, lung, or section of the colon. Radiation and surgery can be used individually or together, and they can be combined individually or together with chemotherapy drugs.

### An Inauspicious Beginning

The first successful cancer chemotherapy was not originally designed to save lives, but to end them. It was mustard gas, a chemical weapon first used during World War I that caused severe blistering, especially to the eyes and the respiratory system.

During a particular military operation in the 1940s, a group of people who had been accidentally exposed to mustard gas was later found to have very low white blood cell counts. If the chemical could damage rapidly growing white blood cells, scientists wondered, would it do the same thing to rapidly growing *cancer* cells? To find out, they injected mustard gas into the veins of several patients with advanced lymphomas, choosing that method since the gas is too irritating to breathe. Their improvement, although temporary, was remarkable.

That experience led researchers to look for other chemicals that might have similar effects against cancer. Since then, hundreds of chemo drugs have been developed to treat cancer, and research continues to be promising in this field.

### How Chemotherapy Works

To understand how chemotherapy drugs work, it helps to understand how cells work. All living tissue is composed of cells. Cells grow and reproduce to replace cells lost due to injury or normal wear and tear. The *cell cycle* is a series of steps that both normal cells and cancer cells go through as they grow and reproduce.

There are five phases in the cell cycle, with each phase designated by letters and numbers:

- **G0 phase:** This is the resting phase, when cells have not yet started to divide. Cells spend much of their lives in this phase. Depending on the type of cell, this phase can last for a few hours to a few years. When the cell receives the signal to reproduce, it moves into the G1 phase.
- **G1 phase:** The cell starts making more proteins to get ready to divide. This phase lasts about 18 to 30 hours.
- **S phase:** The chromosomes containing the genetic code (DNA) are copied so that both of the new cells formed will have the right amount of DNA. This phase lasts about 18 to 20 hours.
- **G2 phase:** This is the period just before the cell begins to split. It lasts from two to 10 hours.
- **M phase:** During this phase, known as mitosis, the cell actually splits into two new cells. This phase lasts only 30 to 60 minutes.

Understanding the cell cycle is important because many chemotherapy drugs work only on actively reproducing cells – not those in the resting phase. Some drugs specifically attack cells in the M phase, or the S phase, for instance. And some drugs work in *all* phases of the cell cycle. Based on the cell cycle, doctors can predict which drugs are likely to work well together and how often to administer doses of each drug.

Although chemotherapy drugs attack reproducing cells, they cannot, unfortunately, tell the difference between normal reproducing cells and cancer cells. When chemotherapy damages normal cells, side effects can result. That's why chemotherapy is always a balancing act between destroying the cancer cells (in order to cure or control the disease) and sparing the normal cells (to lessen unwanted side effects).

### The Different Types of Chemotherapy Drugs

Each person's cancer is unique; therefore, so is his or her chemotherapy plan.

Chemotherapy drugs are divided into various groups based on:

- How they affect specific chemical substances within cancer cells
- Which cellular activities or processes the drug interferes with
- Which specific phases of the cell cycle the drug affects

#### Alkylating Agents

Alkylating agents directly damage DNA to prevent the cancer cell from reproducing. As a class of drugs, these agents are not phase-specific – in other words, they work in all phases of the cell cycle. These drugs are active against chronic leukemia, non-Hodgkin lymphoma, Hodgkin disease, multiple myeloma, and lung, breast, ovarian, and certain other cancers.

#### Nitrosoureas

Nitrosoureas act in a similar way to alkylating agents. They interfere with enzymes that help copy and repair DNA. They, too, are not phase specific. Unlike many other drugs, these agents are able to cross the blood-brain barrier, so they are often used to treat brain tumors. They are also used to treat Hodgkin and non-Hodgkin lymphomas, multiple myeloma, and malignant melanoma.

#### Antimetabolites

Antimetabolites are a class of drugs that interfere with both DNA and RNA growth. These agents damage cells during the S phase and are commonly used to treat leukemia, tumors of the breast, ovary, and gastrointestinal tract, and other cancers.

#### Anthracyclines and Related Drugs

Anthracyclines are anti-tumor antibiotics that interfere with enzymes involved in DNA replication. These agents work in all phases of the cell cycle. Thus, they are widely used for a variety of cancers. A major consideration when administering these drugs is the toxic effects they can have on heart muscle. For this reason, lifetime dose limitations are often placed on these drugs.

#### Topoisomerase Inhibitors

These drugs interfere with specific enzymes that are important in accurate DNA replication. They are used to treat certain leukemia, as well as lung, ovarian, gastrointestinal, and other cancers.

## Mitotic Inhibitors

Mitotic inhibitors are plant alkaloids and other compounds derived from natural products. They can stop mitosis or inhibit enzymes from making proteins needed for reproduction of the cell. These work primarily during the M phase of the cell cycle but can cause cellular damage in all phases. They are used to treat many different types of cancer including breast, lung, myelomas, lymphomas, and leukemia. These drugs are known for their potential to cause peripheral nerve damage, which can be a dose-limiting side effect.

## Corticosteroid Hormones

Steroids are natural hormones and hormone-like drugs that are useful in treating some types of cancer such as lymphoma, leukemia, and multiple myeloma. These drugs are often combined with other types of chemotherapy drugs to increase their effectiveness.

## How Chemotherapy Drugs Are Administered

Doctors have quite a few choices in how to get a chemotherapy drug into a patient's system. Among the most common methods are:

1. *Oral/PO* – taken by mouth, usually as a pill
2. *Topical* – applied as a cream or lotion that can be absorbed by the skin
3. *Intravenous/IV* – infused through a vein
4. *Intramuscular/IM* – injected into a muscle
5. *Subcutaneous/SQ* – injected under the skin
6. *Intra-arterial* – injected into an artery
7. *Intrathecal* – infused into the central nervous system via the cerebrospinal fluid
8. *Intrapleural* – infused into the chest cavity
9. *Intraperitoneal* – infused into the abdominal cavity
10. *Intravesical* – infused into the bladder
11. *Intralesional/Intratumoral* – injected directly into the tumor

Each method has its pros and cons and carries certain considerations that factor into the choice:

**1-2.** *Oral and topical delivery* of the drugs is convenient, but may not be the best choice for people with skin or stomach sensitivity.

**3.** The *intravenous (IV) method* gets the drug quickly throughout the body. IV therapy is typically given through a vein in the arm or hand, or through a central venous catheter (CVC), that has been implanted into a larger vein in the chest, neck, or arm. Implanted CVCs are particularly good ways to:

- Give several drugs at once
- Reduce the number of needle sticks during long-term therapy
- Administer continuous infusion chemotherapy
- Give drugs that can cause serious damage to skin and muscle tissue if they leak outside of a vein

**4-6.** Depending upon the strength of the chemotherapy drug, *intramuscular and subcutaneous methods* may be too harsh for skin or muscle.

**6-11.** Known as *regional chemotherapy*, these methods deliver high doses of chemotherapy to a specific tumor-bearing area of the body. This exposes the cancer to more medicine than methods that distribute drugs to all parts of the body. It also minimizes side effects elsewhere.

You may be given chemotherapy once a day, once a week, or even once a month, depending on the type of cancer you have and the chemotherapy you are taking. How long you take chemotherapy also depends on the type of cancer and what length of time research has shown produces the best treatment results.

## Talking to Your Doctor

Because cancer is different for everyone, your chemotherapy plan will be designed just for you. Work closely with your doctor to decide what's best. Some tips to consider:

- Ask as many questions as you need to. Your cancer care team will know the most about chemotherapy and how it will work for you.
- Come prepared. Write down your questions ahead of time and don't be afraid to say you are confused. Nothing you say will sound silly or strange to your health care team. All patients receiving chemotherapy have questions.

Here are some good questions to ask your doctor:

- How long will I be getting chemotherapy?
- How will we know if it's working?
- What are the usual side effects of the chemotherapy you recommended?
- Is there any way to make these side effects less severe?
- How long do the side effects last? Are any permanent?
- How will this chemotherapy affect my prognosis (outlook) for cure or long-term survival?
- Will I still be able to work/go to school/care for my family during treatment?
- Is there anything I should do to prepare for chemotherapy?

### Side Effects of Chemotherapy

It may surprise you to learn that some people have no side effects at all from chemotherapy. Others, of course, do. Regardless, nearly all side effects can be remedied and nearly all are temporary.

You can find detailed information about the side effects of chemotherapy by visiting the American Cancer Society Web site, [www.cancer.org](http://www.cancer.org), or by calling 1-800-ACS-2345.

**For more cancer information, call 1-800-ACS-2345  
or visit [www.cancer.org](http://www.cancer.org), anytime, day or night.**

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