

## Chemotherapy

### Overview

Chemotherapy drugs work against one of the primary characteristics of cancer cells, which is that they tend to grow and multiply very quickly. Chemotherapy halts cell growth to prevent cancer cells from making more and more cancer cells. However, chemotherapy drugs also affect normal cells in the body that divide rapidly, such as those found in the hair follicles, blood, and mouth, which can cause side effects.

The purpose of chemotherapy is to kill cancer cells. It is usually used to treat cancer that is *systemic*, meaning that the cancer may be in more than one location or has spread throughout the body. Lymphoma is caused by uncontrolled growth in one of two types of white blood cells called T cells and B cells, both of which travel through the bloodstream. T cells and B cells are important elements of the immune system. One advantage of chemotherapy is that it can also travel in the bloodstream to kill lymphoma cells throughout the body.

Most chemotherapy drugs are given *orally* (pill taken by mouth), *intravenously* (IV; injection directly into the vein), or *subcutaneously* (injected under the skin). The medications are administered one or more times a week for one or more weeks, followed by a rest period. This regular treatment schedule is called a *cycle*. The length of the rest period and the number of cycles vary depending on the particular disease and the type of drug(s) used. For more information on oral chemotherapy agents, please view the Lymphoma Research Foundation's (LRF's) *Oral Agents in Lymphoma* fact sheet at [www.lymphoma.org/publications](http://www.lymphoma.org/publications).

Many patients who are treated for lymphoma are given two or more medications together, called *combination chemotherapy*. These chemotherapy drugs are combined to create a *treatment regimen*, which is a specific schedule that the drugs are given during certain days of each treatment cycle. The reason for using a combination of drugs is to increase how effectively the drugs kill or damage cancer cells. Since cancer cells divide more rapidly than normal cells, they are more sensitive to DNA damage.

Oncology nurses are usually responsible for administering the chemotherapy regimen prescribed by the doctor. Most patients receive their chemotherapy in an outpatient clinic, hospital outpatient department, or physician's office, but sometimes patients have to stay in the hospital to receive their treatment.

### Common Chemotherapy Regimens for Hodgkin Lymphoma (HL) and Non-Hodgkin Lymphoma (NHL)

Many chemotherapy regimens for B-cell NHL include the monoclonal antibody rituximab (Rituxan), which is an immunotherapy. Rituximab is usually abbreviated with the letter R and placed at the beginning or end of the chemotherapy regimen abbreviation, such as

R-CHOP or CHOP-R (cyclophosphamide [Cytoxan], doxorubicin/hydroxydaunorubicin [Adriamycin], vincristine [Oncovin], and prednisone [Deltasone]). Most of the chemotherapy drugs used in lymphoma treatment have been used for decades, but bendamustine (Treanda) and pralatrexate (Folotyn) were approved in the last few years, along with brentuximab vedotin (Adcetris) which is a monoclonal antibody attached to a toxin.

Bendamustine is an alkylating agent in a class of drugs that causes damage to a cell's DNA. Pralatrexate is an antimetabolite in a class of drugs that interferes with normal DNA production by eliminating folate, which is needed for the creation of DNA. Brentuximab vedotin (Adcetris) is a type of antibody-drug *conjugate* (combination) that is a treatment for HL and anaplastic large cell lymphoma. An *antibody-drug conjugate* is a monoclonal antibody that is linked to a toxin, in this case a chemotherapy agent called monomethyl auristatin E (MMAE). Brentuximab vedotin binds to the *antigen* (target) CD30, which is found on the cells of some forms of lymphoma, and delivers the chemotherapy drug that kills that cancer cell. Each of these drugs is also being investigated for other uses.

The individual and combination chemotherapy regimens listed in the table shown on the next few pages are either currently recommended by the National Comprehensive Cancer Network or not yet approved by the U.S. Food and Drug Administration (FDA) for the treatment of lymphoma. Nearly all of the progress in treating HL and NHL has been gained from information learned from clinical trials. Some of the combinations listed are used in *relapsed* (disease returns after treatment) or *refractory* (disease does not respond to treatment) lymphoma, referred to as secondline therapy because they are given after *frontline* (initial) therapy.

### How Is Chemotherapy Given?

Depending on the regimen, patients will be given chemotherapy in pill form, as an injection under the skin, or as an IV infusion through a vein. A few chemotherapy drugs have to be injected in the space around the spinal cord, called a *lumbar puncture* (spinal tap). In this process, a doctor inserts a thin needle into the lower back after it has been numbed with a local anesthetic.

To make it easier to give and receive multiple cycles of IV chemotherapy into the veins, a doctor or another healthcare team member may insert or implant a *central venous access device*—sometimes called a catheter, port, or central line—into a large blood vessel in the patient's chest. The device may stay in place for a few weeks, for the duration of the chemotherapy treatment, or for several months beyond the duration of chemotherapy. Patients should discuss with their physician which type of central venous access device, if any, would be best for their particular situation.

Regimen Abbreviation	HL	NHL	Medication(s)
ABVD	X*		Doxorubicin/hydroxydaunorubicin (Adriamycin, Rubex) Bleomycin (Blenoxane) Vinblastine (Velban, Velsar) Dacarbazine (DTIC-Dome)
B	X*	X	Bendamustine (Treanda)
BEACOPP	X		Bleomycin (Blenoxane) Etoposide/VP16 (Etopophos, Toposar, Vepesid) Doxorubicin/hydroxydaunorubicin (Adriamycin, Rubex) Cyclophosphamide (Clafen, Cytoxan, Neosar) Vincristine (Oncovin, Vincasar PFS) Procarbazine (Matulane)
Brentuximab vedotin	X	X	Brentuximab vedotin (Adcetris)
C		X*	Cyclophosphamide (Clafen, Cytoxan, Neosar)
ChI	X	X*	Chlorambucil (Leukeran)
ChIVPP	X		Chlorambucil (Leukeran) Vinblastine (Velban, Velsar) Procarbazine (Matulane) Prednisone (Deltasone)
CHOP	X*	X*	Cyclophosphamide (Clafen, Cytoxan, Neosar) Doxorubicin/hydroxydaunorubicin (Adriamycin, Rubex) Vincristine (Oncovin, Vincasar PFS) Prednisone (Deltasone)
CODOXM-IVAC		X	Cyclophosphamide (Clafen, Cytoxan, Neosar) Vincristine (Oncovin, Vincasar PFS) Liposomal doxorubicin (Doxil) Cytarabine/high-dose Ara-C (Cytosar-U, Tarabine PFS) Methotrexate (Otrexup, Rheumatrex, Trexall) Ifosfamide (Ifex) Etoposide/VP16 (Etopophos, Toposar, Vepesid)
CVP (COP)	X	X*	Cyclophosphamide (Clafen, Cytoxan, Neosar) Vincristine (Oncovin, Vincasar PFS) Prednisone (Deltasone)
DHAP	X*	X*	Dexamethasone (Decadron, Dexasone) Cytarabine/high-dose Ara-C (Cytosar-U, Tarabine PFS) Cisplatin (Platinol, Platinol-AQ)
DICE	X*		Dexamethasone (Decadron, Dexasone) Ifosfamide (Ifex) Cisplatin (Platinol, Platinol-AQ) Etoposide/VP16 (Etopophos, Toposar, Vepesid)
EPOCH	X	X*	Etoposide/VP16 (Etopophos, Toposar, Vepesid) Prednisone (Deltasone) Vincristine (Oncovin, Vincasar PFS) Cyclophosphamide (Clafen, Cytoxan, Neosar) Doxorubicin/hydroxydaunorubicin (Adriamycin, Rubex)

\*Rituximab (Rituxan) or other CD20 antibodies may be added.

Regimen Abbreviation	HL	NHL	Medication(s)
ESHAP	X*	X*	Etoposide/VP16 (Etopophos, Toposar, Vepesid) Methylprednisolone (Solu-Medrol) Cytarabine/high-dose Ara-C (Cytosar-U, Tarabine PFS) Cisplatin (Platinol, Platinol-AQ)
FC		X*	Fludarabine (Fludara) Cyclophosphamide (Clafen, Cytoxan, Neosar)
FND		X*	Fludarabine (Fludara) Mitoxantrone (Novantrone) Dexamethasone (Decadron, Dexasone)
GCD	X*		Gemcitabine (Gemzar) Carboplatin (Paraplatin) Dexamethasone (Decadron, Dexasone)
GDP	X*	X*	Gemcitabine (Gemzar) Dexamethasone (Decadron, Dexasone) Cisplatin (Platinol, Platinol-AQ)
GemOX	X*	X*	Gemcitabine (Gemzar) Oxaliplatin (Eloxatin)
GVD	X*		Gemcitabine (Gemzar) Vinorelbine (Navelbine) Liposomal doxorubicin (Doxil)
HD MTX and HD Ara-C		X	High-dose methotrexate (Otrexup, Rheumatrex, Trexall) Cytarabine/high-dose Ara-C (Cytosar-U, Tarabine PFS)
HyperCVAD/MTX-Ara-C	X	X*	Cyclophosphamide (Clafen, Cytoxan, Neosar) Vincristine (Oncovin, Vincasar PFS) Doxorubicin/hydroxydaunorubicin (Adriamycin, Rubex) Dexamethasone (Decadron, Dexasone) Methotrexate (Otrexup, Rheumatrex, Trexall) Cytarabine/high-dose Ara-C (Cytosar-U, Tarabine PFS)
ICE	X*	X*	Ifosfamide (Ifex) Carboplatin (Paraplatin) Etoposide/VP16 (Etopophos, Toposar, Vepesid)
MINE	X	X*	Mesna (Mesnex) Ifosfamide (Ifex) Mitoxantrone (Novantrone) Etoposide/VP16 (Etopophos, Toposar, Vepesid)
MTR		X	Methotrexate (Otrexup, Rheumatrex, Trexall) Temozolomide (Temodar) Rituximab (Rituxan)
P		X	Pralatrexate (Folotyn)
SMILE		X	Methotrexate (Otrexup, Rheumatrex, Trexall) Leucovorin Ifosfamide (Ifex) Mesna (Mesnex) Dexamethasone (Decadron, Dexasone) Etoposide/VP16 (Etopophos, Toposar, Vepesid) Pegaspargase (Oncaspar)
Stanford V	X		Doxorubicin/hydroxydaunorubicin (Adriamycin, Rubex) Vinblastine (Velban, Velsar) Mechlorethamine (Mustargen) Vincristine (Oncovin, Vincasar PFS) Bleomycin (Blenoxane) Etoposide/VP16 (Etopophos, Toposar, Vepesid) Prednisone (Deltasone)

\*Rituximab (Rituxan) or other CD20 antibodies may be added.

## Why Is It Important to Adhere to the Chemotherapy Treatment Schedule?

Patients should adhere to their chemotherapy treatment schedule because the timing of a full course of chemotherapy often works best in the treatment of their disease. In clinical studies, doctors have found that reducing the dose or delaying cycles of chemotherapy to reduce short-term side effects can decrease the treatment benefit for patients with certain types of lymphoma. Some side effects may be unpleasant but tolerable; other side effects may be more serious, but they can often be anticipated and prevented. It is very important that chemotherapy schedules be maintained to the greatest extent possible.

Also a healthy diet is essential for helping a patient's body heal from both lymphoma and its treatments. A healthy diet may help the body endure the side effects of treatment and may limit the need to modify therapy choices. Patients can speak with their healthcare team regarding these issues. For detailed information on nutrition during lymphoma treatment, view LRF's *Nutrition* fact sheet at [www.lymphoma.org/publications](http://www.lymphoma.org/publications).

## Clinical Trials

Clinical trials are crucial in identifying effective drugs and determining optimal doses for patients with lymphoma. Patients interested in participating in a clinical trial should view the *Understanding Clinical Trials* fact sheet on LRF's website at [www.lymphoma.org/publications](http://www.lymphoma.org/publications), talk to their physician, or contact the LRF Helpline for an individualized clinical trial search by calling (800) 500-9976 or emailing [helpline@lymphoma.org](mailto:helpline@lymphoma.org).

## Follow-up

Patients with lymphoma should have regular visits with a physician who is familiar with their medical history and the treatments they have received. Medical tests (such as blood tests, computed tomography [CT] scans, and positron emission tomography [PET] scans) may be required at various times during *remission* (disappearance of signs and symptoms) to evaluate the need for additional treatment.

Some treatments can cause long-term side effects or late side effects, which can vary based on the duration and frequency of treatments, age, gender, and the overall health of each patient at the time of treatment. A physician will check for these side effects during follow-up care. Visits may become less frequent the longer the disease remains in remission.

Patients and their caregivers are encouraged to keep copies of all medical records and test results as well as information on the types, amounts, and duration of all treatments received. This documentation will be important for keeping track of any side effects resulting from treatment or potential disease recurrences. LRF's award-winning *Focus On Lymphoma* mobile app ([www.FocusOnLymphoma.org](http://www.FocusOnLymphoma.org)) can help patients manage this documentation.

## Patient and Caregiver Support Services

A lymphoma diagnosis often triggers a range of feelings and concerns. In addition, cancer treatment can cause physical discomfort. One-to-one peer support programs, such as LRF's *Lymphoma Support Network*, connects patients and caregivers with volunteers who have experience with lymphoma or chronic lymphocytic leukemia/small lymphocytic lymphoma (CLL/SLL), similar treatments, or challenges, for mutual emotional support and encouragement. Patients and loved ones may find this useful whether the patient is newly diagnosed, in treatment, or in remission.

## Resources

LRF offers a wide range of resources that address treatment options, the latest research advances, and ways to cope with all aspects of lymphoma and CLL/SLL including our award-winning mobile app. LRF also provides many educational activities, from in-person meetings to teleconferences and webcasts for people with lymphoma, as well as patient guides and e-Updates that provide the latest disease-specific news and treatment options. To learn more about any of these resources, visit our website at [www.lymphoma.org](http://www.lymphoma.org), or contact the LRF Helpline at (800) 500-9976 or [helpline@lymphoma.org](mailto:helpline@lymphoma.org).

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Supported  
through  
grants from:



Genentech  
A Member of the Roche Group

Biogen

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*Getting the Facts* is published by the Lymphoma Research Foundation (LRF) for the purpose of informing and educating readers. Facts and statistics were obtained using published information, including data from the Surveillance, Epidemiology, and End Results (SEER) Program. Because each person's body and response to treatment is different, no individual should self-diagnose or embark upon any course of medical treatment without first consulting with his or her physician. The medical reviewer, the medical reviewer's institution, and LRF are not responsible for the medical care or treatment of any individual.

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