

Chemotherapy

Overview

Chemotherapy drugs work against the general characteristics of cancer cells, such as their tendency to grow and multiply very quickly. Chemotherapy halts cell growth and division to prevent cancer cells from making more and more cancer cells; however, chemotherapy drugs not only affect the cancer cells, but also any normal rapidly dividing cells, which can cause side effects.

The purpose of chemotherapy is to kill cancer cells. It is usually used to treat cancer when it is *systemic*, meaning that the cancer has spread throughout the body. Lymphoma is caused by uncontrolled growth in one or the other of two types of white blood cells called T cells and B cells. T cells and B cells are important elements of the immune system that can travel through the blood stream. An advantage of chemotherapy is that it can also travel throughout the blood stream to kill the cancer cells wherever they may be located.

During chemotherapy, patients receive the drug or drugs *orally* (pill taken by mouth) or *intravenously* (IV; injection directly into the vein), 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.

Many patients who are treated for lymphoma are given combination chemotherapy, which means two or more drugs, instead of single-drug therapy. These chemotherapy drugs are given in a specific order (*schedule*) during certain days of each treatment cycle—this is called a *treatment regimen*. The reason for using a combination of drugs is to increase how effectively the drugs kill or damage cancer cells.

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 usually abbreviated with the letter R and placed at the beginning or end of the regimen abbreviation, such as R-CHOP or CHOP-R (cyclophosphamide [Cytoxan], doxorubicin [Adriamycin], vincristine [Oncovin], and prednisone [Deltasone]). Most of these chemotherapy drugs have been in use for decades, but several have been developed more recently. Bendamustine (Treanda) is a newer alkylating agent, a class of drugs that causes damage to a cell's DNA. Pralatrexate (Folotylin) is a novel antimetabolite, a class of drugs that interferes with normal DNA production by eliminating folate, which is needed for creation of DNA. Since cancer cells divide more rapidly than normal cells, they are more sensitive to DNA damage.

Bendamustine is approved for the treatment of chronic lymphocytic leukemia (CLL) and also approved for the treatment of indolent B-cell NHL that has progressed during or within six months of treatment with rituximab or a rituximab-containing regimen. Pralatrexate is approved for the treatment of patients with peripheral T-cell lymphoma that has progressed after prior treatment. In addition, brentuximab vedotin (Adcetris) is a type of antibody-drug conjugate 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 targets CD30 found on the cells of some forms of lymphoma and delivers the chemotherapy drug that kills the cancer cell. Each of these drugs is also being investigated for other uses.

The regimens, or combinations, listed in the table below are either currently recommended regimens or under investigation. Nearly all of the progress in treating HLs and NHLs has been gained from information learned from clinical trials. Some of the combinations listed below are used in *relapsed* (disease returns after treatment) or *refractory* (disease does not respond to treatment) lymphoma, referred to as second-line therapy because they are given after *first-line* (initial) therapy.

Regimen Abbreviation	Treatment(s)
ABVD (HL)	Doxorubicin/hydroxydaunorubicin (Adriamycin, Rubex) Bleomycin (Blenoxane) Vinblastine (Velban, Velsar) Dacarbazine (DTIC-Dome)
B (HL and NHL)	Bendamustine (Treanda)
BEACOPP (HL)	Bleomycin (Blenoxane) Etoposide (Etopophos, Toposar, Vepesid) Doxorubicin/hydroxydaunorubicin (Adriamycin, Rubex) Cyclophosphamide (Clafen, Cytoxan, Neosar) Vincristine (Oncovin, Vincasar PFS) Procarbazine (Matulane) Prednisone (Deltasone)

Regimen Abbreviation	Treatment(s)
Brentuximab vedotin (HL* and NHL*)	Brentuximab vedotin (Adcetris)
C (NHL)	Cyclophosphamide (Clafen, Cytoxan, Neosar)
ChI (HL and NHL)	Chlorambucil (Leukeran)
ChIVPP (HL*)	Chlorambucil (Leukeran) Vinblastine (Velban, Velsar) Procarbazine (Matulane) Prednisone (Deltasone)
CHOP or R-CHOP (HL and NHL)	Cyclophosphamide (Clafen, Cytoxan, Neosar) Doxorubicin/hydroxydaunorubicin (Adriamycin, Rubex) Vincristine (Oncovin, Vincasar PFS) Prednisone (Deltasone) ± Rituximab (Rituxan)
Cisplatin + RT + VIPD (NHL)	Cisplatin (Platinol, Platinol-AQ) Radiation therapy VP16 (Etoposide) Ifosfamide (Ifex) Dexamethasone (Decadron, Dexasone)
CODOXM-IVAC (NHL)	Cyclophosphamide (Clafen, Cytoxan, Neosar) Vincristine (Oncovin, Vincasar PFS) Doxorubicin (Doxil) Cytarabine (Cytosar-U, Tarabine PFS) Methotrexate (Otrexup, Rheumatrex, Trexall) Ifosfamide (Ifex) VP16 (Etoposide)
C-MOPP (HL)	Cyclophosphamide (Clafen, Cytoxan, Neosar) Vincristine (Oncovin, Vincasar PFS) Procarbazine (Matulane) Prednisone (Deltasone)
CVP (COP; HL and NHL)	Cyclophosphamide (Clafen, Cytoxan, Neosar) Vincristine (Oncovin, Vincasar PFS) Prednisone (Deltasone)
DHAP (HL* and NHL)	Dexamethasone (Decadron, Dexasone) Cytarabine (Cytosar, Tarabine PFS) Cisplatin (Platinol, Platinol-AQ)
DICE (HL*)	Dexamethasone (Decadron, Dexasone) Ifosfamide (Ifex) Cisplatin (Platinol, Platinol-AQ) Etoposide (Etopophos, Toposar, Vepesid)
EPOCH (HL and NHL)	Infusional Etoposide (Etopophos, Toposar, Vepesid) Prednisone (Deltasone) Infusional Vincristine (Oncovin, Vincasar PFS) Cyclophosphamide (Clafen, Cytoxan, Neosar) Doxorubicin/hydroxydaunorubicin (Adriamycin, Rubex)
ESHAP (HL* and NHL)	Etoposide (Etopophos, Toposar, Vepesid) Methylprednisolone (Solu-Medrol) Cisplatin (Platinol, Platinol-AQ) Cytarabine (Cytosar-U, Tarabine PFS)
FC (NHL)	Fludarabine (Fludara) Cyclophosphamide (Clafen, Cytoxan, Neosar)
FND (NHL)	Fludarabine (Fludara) Mitoxantrone (Novantrone) Dexamethasone (Decadron, Dexasone)

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

*Common second-line regimen.

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How Is Chemotherapy Given?

Depending on the regimen, patients will be given chemotherapy in pill form, as an injection, or as an IV drip through a vein. A few chemotherapy drugs have to be injected in the space around the spinal cord, using a *lumbar puncture* (spinal tap): a process in which 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 chemotherapy by IV, the doctor may insert an IV catheter, or port, that 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 catheter, if any, would be best for their particular situation.

Why Is it Important to Adhere to the Chemotherapy Treatment Schedule?

Patients should adhere to their chemotherapy treatment schedule because a full course of chemotherapy works best in the treatment of their disease. In clinical studies, doctors have found that reducing the dose or delaying chemotherapy can decrease the treatment benefit for patients with certain types of lymphoma. Changing the regimen to reduce short-term side effects may actually be harmful in the long run. Some side effects may be unpleasant but tolerable. Other side effects may be serious but can often be anticipated and prevented. It is very important that chemotherapy schedules be maintained to the greatest extent possible. A healthy diet is essential for helping a patient's body heal from both lymphoma and its treatments. A healthy diet may also help the body endure the side effects of treatment and may limit the need to modify therapy choices. Patients should speak with their healthcare team regarding these issues or for more information on nutrition, view LRF's *Nutrition* fact sheet at www.lymphoma.org.

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, 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.

Follow-up

Patients in remission 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 and computed tomography [CT], magnetic resonance imaging [MRI], and/or positron emission tomography [PET] scans) may be required at various times during remission to evaluate the need for additional treatment.

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 effects resulting from treatment or potential disease recurrences.

Support

A lymphoma diagnosis often triggers a range of feelings and concerns. In addition, cancer treatment can cause physical discomfort. Support groups and online message boards can help patients connect with other people who have lymphoma. One-to-one peer support programs, such as LRF's Lymphoma Support Network, match lymphoma patients (or caregivers) with volunteers who have gone through similar experiences.

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, including our award-winning mobile app. LRF also provides many educational activities, from in-person meetings to teleconferences and webcasts, as well as disease-specific websites, videos, and eNewsletters for current lymphoma information and treatment options. To learn more about any of these resources, visit our website at www.lymphoma.org, or contact the LRF Helpline at (800) 500-9976 or helpline@lymphoma.org.