

Table 18.3 Biologic-Response Therapies Used in Cancer Patients

Medication	Indications	Dosing	Side effects affecting rehab	Dose-limiting toxicities (DLT) and other side effects or considerations
Monoclonal antibodies: Made by injecting human cancer cells or protein into mice. Creates antibodies against the cancer cells that recognize a particular protein and assist with direct or indirect killing effects of the body's immune system.				
Alemtuzumab (Campath)	Chronic lymphocytic leukemia, relapsed or refractory B-cell chronic lymphocytic leukemia, T-cell prolymphocytic leukemia.	30 mg IV/day 3 times/wk for maximum of 12 wk.	Cog: ++ S: ++ A: 0 Motor: ++ D: +++ Com: ++ F: ++	DLT: Severe prolonged myelosuppression of white cells, red cells, and platelets (pancytopenia with marrow hypoplasia, which can be fatal, occurs in rare instances), immunosuppression (recovery of CD4 and CD8 counts may take >1 yr). Severe infusion-related fever, chills, nausea, vomiting, urticaria, skin rash, fatigue, headache, diarrhea, dyspnea, hypotension, mucositis, edema, Premedicate with diphenhydramine and acetaminophen. Start with a low dose and gradually increase to full dose. Infuse over 2 h to reduce infusion reactions. Patient should receive prophylaxis therapy for <i>Pneumocystis carinii</i> , cytomegalovirus, herpes zoster, <i>Candida</i> , <i>Cryptococcus</i> , and <i>Listeria</i> meningitis infection until CD4 counts are >200. Drug interactions: None known.
Bortezomib (Velcade)	Relapsing or refractory multiple myeloma, non-Hodgkin's lymphoma.	1.3 mg/m ² IV twice/wk for 2 wk (days 1, 4, 8, and 11) followed by 10-day rest period (days 12-21).	Cog: ++ S: ++ A: 0 Motor: ++++ D: ++ Com: ++ F: ++++	DLT: Nausea, vomiting, diarrhea. Myelosuppression with thrombocytopenia and neutropenia. Peripheral sensory neuropathy or sensorimotor neuropathy (improves with discontinuation). Others: Orthostatic hypotension (12%), fever (40%); fatigue, malaise, and generalized weakness (onset during the first and second cycles of therapy). Drug interactions: None known.
Gemtuzumab (Mylotarg)	Acute myelogenous leukemia.	9 mg/m ² IV over 2 h. Usually 2 doses; second dose is administered 14 days after first dose.	Cog: ++ S: ++ A: 0 Motor: 0 D: ++ Com: ++ F: ++	DLT: Myelosuppression is dose-limiting toxicity; neutropenia and thrombocytopenia. Patients frequently require red blood cell and platelet transfusions. Infusion-related symptoms within 2 h of infusion (fever, chills, nausea, vomiting, urticaria, skin rash, fatigue, headache, diarrhea, dyspnea, hypotension; incidence decreases with second dose); premedicate with diphenhydramine and acetaminophen. Others: Hepatotoxicity (20%), increased bilirubin and liver enzymes, nausea, vomiting, mucositis, rare cases of veno-occlusive disease. Drug interactions: None known.
Rituximab (Rituxan)	Non-Hodgkin's lymphoma. Binds to CD20 and causes cell lysis via antibody or complement binding; used as a single agent or	375 mg/m ² IV weekly for 4 or 8 wk. Start infusion slowly and increase rate as tolerated.	Cog: 0 S: 0 A: 0 Motor: 0 D: + Com: 0 F: 0	DLT: Infusion-related symptoms within 30 min-2 h of dose (fever, chills, urticaria, flushing, fatigue, headache, bronchospasm, rhinitis, dyspnea, angioedema, nausea, hypotension). Tumor lysis syndrome within first 12-24 hrs of treatment. Mucocutaneous reactions (pemphigus, Stevens-Johnson syndrome, lichenoid dermatitis, toxic epidermal neurolysis; usual onset from 1-13

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Medication	Indications	Dosing	Side effects affecting rehab	Dose-limiting toxicities (DLT) and other side effects or considerations
	in combination with chemotherapy regimens.			wk after dose; requires drug discontinuation). Others: Arrhythmias, chest pain, mild nausea, vomiting, rare myelosuppression, respiratory symptoms in 40%, cough, rhinitis, dyspnea, sinusitis. Drug interactions: None known.
Tositumomab (Bexxar)	Relapsed or refractory CD20-positive, follicular non-Hodgkin's lymphoma.	Administered with potassium iodine solution and radioactive iodine. Day 0: Give Lugol's solution. Day 1: 450 mg. Days 7-14: 450 mg. Days 8-21: Give Lugol's solution.	Cog: + S: + A: 0 Motor: 0 D: + Com: 0 F: 0	DLT: Myelosuppression is most common side effect; all elements affected. Nadir at 4-7 wks; recovery is 30 days, but cytopenias may persist for 12 wk in 5-7% of patients. Others: Infusion-related symptoms (fever, chills, urticaria, flushing, fatigue, headache, bronchospasm, rhinitis, dyspnea, angioedema, nausea, hypotension; usually resolve upon slowing or interrupting infusion), mild nausea, vomiting, mild asthenia and fatigue (40%), infections (45%), hypothyroidism. Drug interactions: None known.
Trastuzumab (Herceptin)	Metastatic breast cancer. Binds to HER-2, causing antibody-dependent cell lysis.	4 mg/kg IV over 90 min, followed by maintenance dose of 2 mg/kg IV over 30 min weekly as tolerated.	Cog: + S: + A: 0 Motor: + D: + Com: 0 F: 0	DLT: Infusion-related symptoms in 40%-50% with initial dose; fever, chills, urticaria, flushing, fatigue, headache, bronchospasm, dyspnea, angioedema, hypotension. Infusion-related reactions can also include anaphylaxis and pulmonary toxicity (dyspnea, pulmonary infiltrates, effusions, pulmonary edema, ARDS). Cardiotoxicity (dyspnea, peripheral edema, reduced left ventricular function which is reversible). Patients should undergo baseline and periodic evaluation of cardiac function. Risk is increased with past or concurrent use of anthracyclines or cyclophosphamide (Cytosan). Others: Generalized pain, asthenia, headache, mild nausea, vomiting, diarrhea. Drug interactions: Additive immunosuppression with other chemotherapy agents, avoid administration of live vaccines as these may result in disseminated infections, immunize patient prior to treatment.
Interferon: Makes cancer cells more easily recognized by the cells of the immune system.				
Interferon alpha (Roferon, Intron-A)	Malignant melanoma, chronic myelogenous leukemia, hairy cell leukemia, Kaposi's sarcoma related to acquired immune deficiency	Dosing varies with indication. Degraded in the renal tubules; half-life is 4-5 h. Biologic effects peak at 24-48 hrs and may persist for	Cog: +++ S: +++ A: ++ Motor: ++ D: ++ Com: + F: ++	DLT: Fatigue and anorexia are dose-limiting toxicities. Others: Flu-like syndrome (fever, chills, malaise, myalgias, headache; develops over 1-2 wk; manage with acetaminophen), mild myelosuppression, dose-related gastrointestinal side effects, elevated liver enzymes. Depression, mental slowing, and memory loss increase with chronic use. Rare instances of mania, severe depression, and suicidal behaviors.

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	syndrome, cutaneous T-cell lymphoma, multiple myeloma, non-Hodgkin's lymphoma, renal cell cancer, hemangioma.	several days.		Antidepressants may manage depression side effects. Drug interactions: Increases effects of phenytoin and phenobarbital due to inhibition of their CYP450 metabolism.
Interleukins: Promote B- and T-cell proliferation; initiate a cytokine cascade that increases levels of natural killer cells; increases tumor cell death without damaging normal cells.				
Interleukin-2 (Aldesleukin)	Renal cell cancer, malignant melanoma.	Dosing varies with indication.	Cog: +++ S: +++ A: ++ Motor: +++ D: ++ Com: ++ F: +++	DLT: Vascular leak syndrome is dose-limiting toxicity (weight gain, arrhythmias, hypotension, edema, oliguria, renal insufficiency, pleural effusion, pulmonary congestion). Others: Delirium, confusion, somnolence, memory impairment, flu-like symptoms (fever, chills, malaise, myalgias, arthralgias; 100%), elevated hepatic enzymes (bilirubin reverses 4-6 days after dose), changes in thyroid function, skin rash, itching, myelosuppression with neutropenia, thrombocytopenia, and anemia. Drug interactions: Steroids can decrease dose-limiting toxicities but can also decrease antitumor effects of interleukin-2. Nonsteroidal anti-inflammatory drugs may increase capillary leak syndrome. Potentiates effects of hypotensive agents; administration requires holding these agents for 12-24 hrs prior to dose.
Denileukin diftitox (Ontak)	T-cell lymphoma.	9-18 mcg/kg/day infused over 30-60 min for 5 days every 21 days for 5 cycles. Administered IV and rapidly distributed. Half-life is 70-80 min. Metabolized by proteolytic degradation.	Cog: + S: + A: + Motor: +++ D: +++ Com: + F: +++	DLT: Hypersensitivity reactions (hypotension, back pain, dyspnea, chest pain; 70% of patients) within 24 h of infusion, anaphylaxis occurs in 1%-2% of patients. Prevent infusion-related reactions by using antihistamines and acetaminophen; avoid steroid pretreatment. Vascular leak syndrome (hypotension, edema). Delayed and prolonged diarrhea, anorexia, nausea, vomiting; pretreat. Others: Elevated liver enzymes (resolve within 2 wk of dosing). Drug interactions: None known.
Immodulator and antiangiogenic agent: Thalidomide (Thalomid)	Multiple myeloma, erythema nodosum leprosum, myelodysplastic disease, solid	Dosing varies with protocol.	Cog: ++ S: ++ A: 0 Motor: ++++ D: ++ Com: ++ F: ++	DLT: Neurotoxic effects (orthostatic hypotension, dizziness, peripheral neuropathy in the form of numbness, tingling, and pain in the feet or hands), constipation (common). Serious dermatologic reactions including Stevens-Johnson syndrome (development of skin rash during therapy requires discontinuance).

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	tumors.			Others: Milder maculopapular skin rash, urticaria, dry skin, sedation or fatigue following an evening dose (occurs with larger initial doses; manage with dose reduction), increased risk of deep venous thrombus and pulmonary embolism. Teratogenic. Drug interactions: Sedative effect is enhanced with concurrent use of barbiturates, chlorpromazine, reserpine, or alcohol.
Hormone therapies				
Antiestrogen: Tamoxifen (Nolvadex)	Used to prevent osteoporosis and recurrence of breast cancer in premenopausal and hormone receptor-positive patients.	20 mg/day.	Cog: 0 S: 0 A: 0 Motor: 0 D: ++ Com: 0 F: 0	Menopausal symptoms (hot flashes, nausea, vomiting, vaginal bleeding, menstrual irregularities), vaginal discharge, vaginal dryness, skin rash, pruritus, hair thinning, elevations in serum triglycerides, fluid retention and peripheral edema (30%), tumor flare (usually occurs within first 2 wk of starting therapy), nausea, vomiting, anorexia, increased risk of endometrial cancer, ocular toxicity with cataract formation and xerophthalmia. Deep vein thrombosis, pulmonary embolism, and superficial phlebitis are rare but may be increased when administered concomitantly with chemotherapy. Drug interactions: Can increase anticoagulant effect of warfarin (Coumadin). Bromocriptine increases levels and effects. Inhibits CYP P450 metabolism and increases levels and effects of cyclophosphamide, erythromycin, calcium channel blockers, and cyclosporine.
Antiestrogen: Raloxifene (Evista)	Used to prevent and treat osteoporosis in postmenopausal women and to prevent recurrence of breast cancer in postmenopausal patients.	60 mg/day.	Cog: 0 S: 0 A: 0 Motor: 0 D: ++ Com: 0 F: 0	DLT: Deep vein thrombosis, pulmonary embolism, and superficial phlebitis are rare but may be increased when given concomitantly with chemotherapy. Ocular toxicity with cataract formation and xerophthalmia. Others: Menopausal symptoms (hot flashes, nausea, vomiting, vaginal bleeding, menstrual irregularities), vaginal discharge, vaginal dryness, skin rash, pruritus, hair thinning, elevations in serum triglycerides, fluid retention and peripheral edema (30%), tumor flare (usually occurs within the first 2 wk of starting therapy), vomiting, anorexia, increased risk of endometrial cancer, nausea.
Antiestrogen: Toremifene (Fareston)	Used to prevent osteoporosis and breast cancer recurrence in hormone receptor-positive and negative patients.	60 mg/day.	Cog: 0 S: 0 A: 0 Motor: 0 D: ++ Com: 0 F: 0	DLT: Deep vein thrombosis, pulmonary embolism, and superficial phlebitis are rare but may be increased when given concomitantly with chemotherapy; ocular toxicity with cataract formation and xerophthalmia. Others: Menopausal symptoms (hot flashes, nausea, vomiting, vaginal bleeding, menstrual irregularities), vaginal discharge, vaginal dryness, skin rash, pruritus, hair thinning, elevations in

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				<p>serum triglycerides, fluid retention and peripheral edema (30%), tumor flare (usually occurs within the first 2 wk of starting therapy), vomiting, anorexia, increased risk of endometrial cancer, nausea.</p> <p>Drug interactions: Thiazide diuretics decrease the renal clearance of calcium and increases the risk of hypercalcemia associated with toremifene. Increases anticoagulant effect of warfarin (Coumadin).</p> <p>Phenobarbital, carbamazepine, and phenytoin increase metabolism, decreasing levels and effects.</p> <p>Ketoconazole and erythromycin inhibit metabolism, increasing levels and effects.</p>
Progestin: Medroxyprogesterone acetate	Second-line therapy with tamoxifen for breast cancer patients.	400-1000 mg IM/wk.	Cog: 0 S: 0 A: 0 Motor: + D: 0 Com: 0 F: 0	<p>Weight gain, hot flashes, vaginal bleeding, edema, increased risk of thrombus formation</p> <p>Drug interactions: None identified.</p>
Progestin: Megestrol acetate	Second-line therapy with tamoxifen for breast cancer patients.	40 mg 3 times/day.	Cog: 0 S: 0 A: 0 Motor: + D: 0 Com: 0 F: 0	<p>Weight gain, hot flashes, vaginal bleeding, edema, increased risk of thrombus formation.</p> <p>Drug interactions: None identified.</p>
LHRH analog: Leuprolide (Lupron)	Used in prostate and breast cancers to induce medical castration by decreasing gonadotropin-releasing hormone activity (agonist), decreasing hormone production.	7.5 mg subcutaneously every 28 days.	Cog: 0 S: 0 A: 0 Motor: 0 D: + Com: 0 F: 0	<p>Amenorrhea, hot flashes, occasional nausea.</p> <p>Drug interactions: None identified.</p>

Medication	Indications	Dosing	Side effects affecting rehab	Dose-limiting toxicities (DLT) and other side effects or considerations
LHRH analog: Goserelin (Zoladex)	Used in prostate and breast cancers to induce medical castration by decreasing gonadotropin-releasing hormone activity (agonist), decreasing hormone production.	3.6 mg subcutaneously every 28 days.	Cog: 0 S: 0 A: 0 Motor: 0 D: + Com: 0 F: 0	Amenorrhea, hot flashes, occasional nausea. Drug interactions: None identified.
Antiestrogen: Anastrozole (Arimidex)	Aromatase inhibitor; blocks the effects of estrogen on estrogen receptors in patients with early breast cancer and metastatic breast cancer.	1 mg/day.	Cog: + S: + A: 0 Motor: + D: + Com: 0 F: +	Profile of aromatase inhibitors is more favorable than that of aminoglutethimide: Nausea, hot flashes, mild fatigue. Increases in cholesterol may occur; lipid profile monitoring recommended. Drug interactions: None identified.
Antiestrogen: Letrozole (Femara)	Aromatase inhibitor; blocks the effects of estrogen on estrogen receptors in patients with early breast cancer and metastatic breast cancer.	2.5 mg/day.	Cog: + S: + A: 0 Motor: + D: + Com: 0 F: +	Profile of aromatase inhibitors is more favorable than that of aminoglutethimide: Nausea, hot flashes, mild fatigue. Increases in cholesterol may occur; lipid profile monitoring recommended. Drug interactions: None identified.
Antiestrogen: Exemestane (Aromasin)	Aromatase inhibitor; blocks the effects of estrogen on estrogen receptors in patients with early breast cancer and metastatic breast cancer.	2.5 mg/day.	Cog: + S: + A: 0 Motor: + D: + Com: 0 F: +	Profile of aromatase inhibitors is more favorable than that of aminoglutethimide: Nausea, hot flashes, mild fatigue. Increases in cholesterol may occur; lipid profile monitoring recommended. Drug interactions: None identified.
Antiestrogen: Aminoglutethimide (Cyadren)	Block the effects of estrogen on estrogen receptors in patients with early breast	250 mg by mouth 4 times/day with hydrocortisone 40 mg/day.	Cog: ++ S: ++ A: 0 Motor: +++ D: + Com: +	Lethargy, rash, orthostasis, ataxia, nystagmus, nausea. Drug interactions: Decreases conversion of cholesterol to glucocorticoids; must be administered with hydrocortisone.

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	cancer and metastatic breast cancer.		F: +++	
Dexamethasone (Decadron)	Steroid used to manage hematologic malignancies due to cytotoxic effects; used in supportive care of patients.	4 mg 4 times/day. With spinal compression: 10-100 mg loading dose, then 4-24 mg 4 times/day.	Cog: + S: 0 A: + Motor: + D: + Com: 0 F: +	Immunosuppression, hyperglycemia, mental status changes, edema, weight gain. Preferred (minimal mineralocorticoid effect and fewer psychiatric side effects) in treatment of cerebral edema associated with brain metastases or cranial irradiation, spinal cord treatment of nausea and vomiting, hypercalcemia, transfusion reactions, appetite stimulation, pneumonitis associated with chemotherapy or radiation, preventing allergic reactions, fluid retention from chemotherapy agents, treatment of graft-versus-host disease and compression associated pain. Drug interactions: Increased immunosuppression and infection risk with other immunosuppressives, antagonizes hypoglycemic effects of diabetic agents.

Cog = cognition; S = sedation; A = agitation or mania; Motor = discoordination; D = dysphagia; Com = communication; F = falls; DLT = dose limiting toxicities; LHRH = luteinizing hormone releasing hormone; HER-2 = human epidermal growth factor receptor 2; ARDS = acute respiratory distress syndrome; mcg = microgram (1/1000 of a milligram); IV = intravenous; SC = subcutaneous.

The likelihood rating scale for encountering the side effects is as follows: 0 = Almost no probability of encountering side effects. + = Little likelihood of encountering side effects. +/++ = Low probability of encountering side effects; however, probability increases with increased dosage. ++ = Medium likelihood of encountering side effects. +++ = High likelihood of encountering side effects, particularly with high doses. ++++ = Highest likelihood of encountering side effects; best to avoid in at-risk patients.