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Chemotherapy and Biotherapeutic Agents for Autoimmune Diseases

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New trends have emerged in treating patients with autoimmune diseases with medications traditionally used in oncology. This article will summarize a comprehensive literature review performed to identify effective chemotherapy and biotherapeutic agents for treating each of the main autoimmune subtypes (nervous, gastrointestinal, blood and blood vessel, skin, endocrine, and musculoskeletal systems). In addition to agents currently used, some of the newer therapeutic options show great promise to radically improve treatment choices when considering individualized plans. Improved outcomes and symptom management using newer nontraditional therapies provide a great impetus for oncology and nononcology healthcare professionals to remain abreast of the advancements made to current treatment options. All nurses (oncology and nononcology) need to be aware of these new trends and strengthen their understanding of certain oncology medications and their side effects, as well as establish the safe-handling practices necessary to administer these agents. The Oncology Nursing Society's Treatment Basics Course is one option that can provide nononcology nurses with the knowledge needed to fulfill new practice gaps. In addition, oncology nurses need to be aware of the many autoimmune diseases that may be treated with chemotherapy or biotherapy.

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New trends have emerged in treating patients with autoimmune diseases with medications traditionally used in oncology, such as chemotherapy and biotherapeutic agents. Those hazardous drugs (HDs) possess potentially dangerous patient side-effect profiles, along with risks of exposure to those administering the drugs. Oncology nurses can receive specific training offered by the Oncology Nursing Society (ONS) on administering these medications and are required by their institution to be chemotherapy and biotherapy certified before administering these drugs. However, treatment with chemotherapy and biotherapeutic agents for autoimmune diseases takes place in nononcology settings by nursing staff who often do not have the knowledge and expertise to administer these types of medications safely or to protect themselves from unnecessary exposure. Although national certification is not required for nononcology nurses to administer HDs to the autoimmune population, growing concerns exist across the United States regarding the establishment of consistent standards that ensure competence in this area to support patient and nurse safety. This article will summarize a comprehensive literature review using an Ovid MEDLINE® search of effective HDs in treating refractory autoimmune diseases.

Background

About 150 autoimmune diseases, which comprise the third most common major illness group in the United States behind heart disease and cancer, respectively, have been identified (see Figure 1 for most common), and their effects can range from mild to life-threatening (American Autoimmune Related Diseases Association [AARDA], 2000a; ONS, 2010). These diseases can affect practically any cell, tissue, organ, or system in the body. More than 50 million Americans suffer from at least one autoimmune disease, with a predicted trend of increased incidence (AARDA, 2012). Seventy-five percent to 85% of autoimmune diseases occur in women, with most being diagnosed during childbearing years (AARDA, 2000b). Although many autoimmune diseases remain poorly understood, one theory states that their substantial prevalence in women is from hormonal imbalances secondary to estrogen metabolites that can damage cellular DNA, which the immune system attacks

- Addison's disease
- Alopecia areata
- Antiphospholipid syndrome
- Autoimmune hemolytic anemia
- Celiac disease
- Chronic active hepatitis
- Chronic urticaria
- Churg-Strauss syndrome
- Giant cell arteritis
- Glomerulonephritis
- Goodpasture's syndrome
- Graves' disease
- Guillain-Barré syndrome
- Hashimoto's thyroiditis
- Idiopathic thrombocytopenia purpura
- IgA nephropathy
- Inflammatory bowel disease
- Mixed connective tissue disease
- Multiple sclerosis
- Myasthenia gravis
- Pemphigus
- Pernicious anemia
- Polymyalgia rheumatica
- Primary biliary cirrhosis
- Psoriasis
- Reiter's syndrome
- Rheumatoid arthritis
- Sarcoidosis
- Scleroderma
- Sjögren's syndrome
- Systemic lupus erythematosus
- Type I diabetes
- Uveitis
- Vasculitis
- Vitiligo
- Wegener's granulomatosis

FIGURE 1. Common Autoimmune Diseases

Note. From "Nononcologic Use of Chemotherapy," by P. I. Geddie, 2008, *Journal of Infusion Nursing, 31*(1), p. 29. Copyright 2008 by Wolters Kluwer Health. Reprinted with permission.

(ONS, 2010). In addition, autoimmune diseases as a whole are among the top 10 leading causes of death in women younger than 65 years (AARDA, 2012; National Institutes of Arthritis and Musculoskeletal and Skin Diseases, 2006). Given the magnitude of these statistics, medical and nursing professionals require additional education about autoimmune diseases and specific training in safe-handling practices because of the hazardous nature of the drugs used to treat them.

The realm of biotherapy inquiry has generated a better understanding of the pathophysiologic processes leading to autoimmune diseases as a result of the Human Genome Project, originally published in 2003 (U.S. Department of Energy Genome Program's Biological and Environmental Research Information System, 2011). With continued research delving into the complexities of the immune system, hundreds of agents are actively being developed by the pharmaceutical industry to address these patient needs, including cytokines (e.g., interferons, interleukins, hematopoietic growth factors), monoclonal antibodies (e.g., humanized and chimeric antibodies), differentiation agents (e.g., retinoids), cellular therapies (e.g., lymphokine-activated killer cells), immunostimulants (e.g., vaccines), and gene therapies (e.g., viral vectors) (Vizcarra & Belcher, 2006). In addition, early success of many of those drug therapies has been documented in the literature, with them alleviating some of the signs and symptoms of refractory autoimmune diseases.

Biotherapeutic agents carry numerous serious potential side-effect profiles, depending on the specific drug and mechanism of action. Some of the adverse drug reactions noted include life-threatening infections, potential allergic reactions ranging from mild pruritus to life-threatening anaphylactic shock, local injection-site reactions, and even malignancies in some cases. Other potential consequences include lupus-like syndromes, aseptic meningitis, congestive heart failure, liver disease, demyelinating diseases, and serious hematologic effects (Vizcarra & Belcher, 2006). In addition, drug side-effect profiles tend to be similar among patients with cancer and those with autoimmune diseases; however, they typically are dose dependent and, therefore, occur with less frequency and severity in autoimmune patients because of lower prescribed drug doses. Several factors, some not well understood, contribute to patients' overall risk for complications, including comorbid conditions; age; functional status; and a specific drug, its dose, and frequency. Potentially life-threatening hypersensitivity reactions and secondary infections remain serious concerns for healthcare professionals caring for autoimmune patients treated with cancer drugs. In addition, chemotherapy and biotherapeutic agents can cause serious toxicities during accidental exposures to individuals who handle these agents through absorption, inhalation, and ingestion routes (ONS, 2010). Characteristics of HDs (to humans or animals) include carcinogenicity, teratogenicity (fetal effects) or other developmental toxicity, reproductive toxicity, organ toxicity at low doses, and genotoxicty (permanent ill effects to DNA and genes) (American Society of Health-System Pharmacists, 2006; National Institute of Occupational Safety and Health, 2004). To further complicate matters, no safe exposure limits have been established (Occupational Safety and Health Administration, 1995).

Literature Review

Most of the early studies investigating new biotherapies in patients with autoimmune diseases occurred through observational case studies on convenience samples that were compared to traditional therapies. However, more recently, numerous randomized, double-blind research protocols have taken place or currently are underway investigating newer drug therapies in the different autoimmune populations. Some significant findings of effective chemotherapy and biotherapeutic agents when compared to standard treatment for autoimmune diseases—including those of the nervous, gastrointestinal, blood and blood vessel, skin, endocrine, and musculoskeletal systems—follow (see Table 1).

Nervous System

Multiple sclerosis (MS), Myasthenia gravis, Guillain-Barré syndrome, and autoimmune uveitis are serious life-altering diseases with well-established autoimmune etiologies. Several studies using chemotherapy and biotherapeutic agents demonstrated positive results in the treatment for some of these diseases. However, according to a Society of Expert Opinion paper, most patients require a lifetime of treatment (National Multiple Sclerosis Society, 2008). MS can manifest several patterns of disease progressions, including clinically isolated syndromes and relapsing-remitting, secondary-progressive, primary-progressive, and progressive-relapsing types (MS ActiveSource, 2011).

Interferons (IFNs), belonging to a large class of glycoproteins called cytokines, are proteins made and released by host cells in response to the presence of pathogens such as viruses, bacteria, parasites, or tumor cells. IFN beta-1-alpha effectively and consistently reduces early inflammatory damage to myelin

and protects axons when started early in the disease course of relapsing-remitting MS (RRMS) and just as much in secondary-progressive MS, except in select cases when disabling relapses occurred within the previous two years (Bates, 2011). Side effects of IFN beta-1-alpha can include flu-like symptoms (e.g., fever, chills, headache, muscle aches and pains, malaise), injection-site reactions, depression and suicide, nausea, vomiting, diarrhea, anorexia, and dizziness, as well as allergic and anaphylactic reactions.

SENTINEL was a two-year, randomized, multicenter, placebo-controlled, double-blind study of 1,171 people taking IFN beta-1-alpha who continued to experience disease activity in MS (Ghezzi et al., 2010). Participants received either natalizumab or placebo in addition to IFN beta-1-alpha. Natalizumab is a humanized monoclonal antibody against the cellular adhesion molecule α4-integrin that confers mechanical stability on interactions between cells and their environment. Side effects of natalizumab can include fatigue, headache, rash, infections, nausea, and arthralgia, along with a black box warning of risk of progressive multifocal leukoencephalopathy, an opportunistic viral infection of the brain that usually leads to death or severe disability. The Kurtzke Expanded Disability Status Scale (EDSS) is a method of quantifying eight neurologic functional systems (pyramidal, cerebellar, brain stem, sensory, bowel and bladder, visual, cerebral, and other) and measuring disability in patients with MS. EDSS steps 1.0–4.5 refer to ranging disabilities measured in ambulatory patients with MS, whereas EDSS steps 5.0–9.5 correlate with ranging disabilities measured in nonambulatory patients with MS. In Ghezzi et al. (2010), natalizumab 300 mg via IV once every 28 days correlated with decreased EDSS scores in 19 pediatric patients with MS during a mean treatment period of 15.2 months.

In the AFFIRM trial, monotherapy with natalizumab was compared to placebo for RRMS in 942 patients, 627 of whom received the monoclonal antibody. After two years, natalizumab reduced the risk of sustained disability progression by 42% (almost twice the effect of the monoclonal antibody-treated group in SENTINEL) and reduced the rate of clinical relapse at one year by 68% (Bielekova & Becker, 2010).

In addition, a phase II study involving 30 patients with an MS relapse within the past 18 months, despite the use of an injectable disease-modifying agent, showed that gadolinium-enhancing (GdE) lesions linked to MS were reduced after treatment with rituximab. Gadolinium is a chemical compound (contrast material) given during magnetic resonance imaging (MRI) scans that highlights areas of new (i.e., less than six weeks old) inflammation. A GdE MRI scan shows active lesions, meaning that a breakdown of the blood-brain barrier and inflammation are present. Rituximab is a chimeric murine/human immunoglobulin G (IgG) 1 kappa monoclonal antibody that targets CD20 exclusively expressed on pre-B cells and mature B cells and causes lysis of circulating B cells. Side effects of rituximab can include fever, rigors, chills, asthenia, body aches, headaches, pruritis, and hypotension, along with a black box warning of fatal infusion reactions within 24 hours of the infusion (about 80% occurring with the first dose). Seventy-four percent of post-treatment MRI scans were free of GdE activity as compared to only 26% being free of GdE activity at baseline. That resulted in an overall 88% decrease in mean GdE lesions while EDSS remained stable (Naismith et al., 2010).

TABLE 1. Proven Beneficial Chemotherapy or Biotherapeutic Agents

Disease	Agent
Neurologic	
Multiple sclerosis	Interferon, natalizumab, rituximab, or high-dose cyclophosphamide without stem cell rescue
Myasthenia gravis	Rituximab
Gastrointestinal	
Autoimmune hepatitis	Alemtuzumab or rituximab
Crohn's disease	Infliximab
Blood and Blood Vessels	
Antiphospholipid syndrome	Rituximab
Autoimmune aplastic anemia	High-dose cyclophosphamide without stem cell rescue
Behçet's disease	Etanercept
Cryoglobulinemia	Rituximab
Hemolytic anemia	Rituximab plus alemtuzumab
Immune thrombocytopenic purpura	Rituximab alone or rituximab plus alemtuzumab
Skin	
Chronic autoimmune urticaria	Omalizumab
Psoriasis	Ustekinumab
Endocrine	
Grave's disease	Rituximab
Musculoskeletal	
Polychondritis	Infliximab
Rheumatoid arthritis	Infliximab and methotrexate or methotrexate alone
Sarcoidosis	Infliximab
Sjögren's syndrome	Rituximab
Systemic lupus erythematosus (SLE)	Rituximab
SLE with autoimmune thrombocytopenia or autoimmune hemolytic anemia	Rituximab

Note. Based on information from Bates, 2011; Bielekova & Becker, 2010; Colombel et al., 2010; DeZern et al., 2011; Efthimiou & Markenson, 2005; El Fassi et al., 2007; Ghezzi et al., 2010; Gladstone et al., 2006; Gómez-Almaguer et al., 2010; Griffiths et al., 2010; Kaplan et al., 2008; Kumar et al., 2009; Kuntzer et al., 2011; Maini et al., 1999; Makhani et al., 2009; Miloh et al., 2007; Naismith et al., 2010; Petek-Balci et al., 2005; Ramos-Casals et al., 2008; Rovelli et al., 2007; St. Clair et al., 2004; Zaja et al., 2010.

Two studies followed patients with MS who did not respond well to standard therapy after receiving high-dose cyclophosphamide without stem cell rescue. Cyclophosphamide is a traditional alkylating chemotherapeutic agent that works by directly slowing or stopping cell growth through the formation of irreversible DNA crosslinks between and within DNA strands, leading to cell death. Side effects of cyclophosphamide can include severe leucopenia and myelosuppression, hair loss, nausea and vomiting, mouth sores, sterility, jaundice, and hemorrhagic cystitis. One multicenter study of 17 children with MS who were treated with cyclophosphamide resulted in a reduction in relapse rate and stabilization of disability scores in a majority of patients assessed one year after treatment (Makhani et al., 2009). Another study involving 12 patients evaluated clinical response after cyclophosphamide (median follow-up of 15 months, range = 6–24 months) (Gladstone et al., 2006). Neurologic improvement was defined as improvements in gait, bladder control, and visual function. Five patients decreased their EDSS scores (Gladstone et al., 2006). These studies confirmed that the administration of high-dose cyclophosphamide without stem cell rescue can result in disease stabilization, improved functionality, and improved quality of life in patients with severe refractory MS. Additional studies are necessary to determine the most appropriate patients for this aggressive treatment.

Concerning Myasthenia gravis, one case report showed an IV administration of four weekly cycles of 375 mg/m^2 of rituximab with a clear clinical improvement documented within 10 days, followed by rapid motor worsening during the next two weeks, relieved with plasma exchange. Two additional cycles of rituximab were given, with complete regression of all signs and symptoms of Myasthenia gravis shortly thereafter with one year to date of remission (Kuntzer, Carota, Novy, Cavassini, & Du Pasquier, 2011).

Gastrointestinal System

Crohn's disease, ulcerative colitis, primary biliary cirrhosis, and autoimmune hepatitis are devastating diseases with known autoimmune pathophysiologies. Infliximab is a chimeric monoclonal antibody consisting of a 25% mouse and 75% human fragment antigen-binding immunoglobulin that binds to soluble and transmembrane tumor necrosis factor (TNF). TNF is a cytokine released primarily by macrophages that begins the acute phase reaction in systemic inflammation. Side effects of infliximab can include rash, abdominal pain, headache, pharyngitis and other infections, fatigue, and nausea and vomiting, along with a black box warning of developing life-threatening infections leading to hospitalization or death.

In a randomized, double-blind trial, the efficacies of infliximab monotherapy, azathioprine monotherapy, and the two drugs combined in 508 adults with moderate-to-severe Crohn's disease who had not undergone previous immunosuppressive or biologic therapy were studied. Of the 169 patients receiving combination therapy, 96 (57%) were in corticosteroid-free clinical remission at week 26 as compared to 75 of 169 patients (44%) receiving infliximab alone and 51 of 170 patients (30%) receiving azathioprine alone. In addition, mucosal healing had occurred in 47 of 107 patients (44%) receiving combination therapy as compared to 28 of 93 patients (30%) receiving infliximab alone and 18 of 109 patients (17%) receiving azathioprine alone. Patients with moderate-to-severe Crohn's disease who were treated with infliximab plus azathioprine or infliximab monotherapy were more likely to have a corticosteroid-free clinical remission than those receiving azathioprine monotherapy (Colombel et al., 2010).

The incidence of autoimmune hepatitis treated with newer, innovative humanized antibody products rarely occurs and remains to be exploited (Luk & Wong, 2006). One patient with giant-cell hepatitis who presented with autoimmune hemolytic anemia was successfully treated, achieving complete and long-lasting remission with alemtuzumab. Alemtuzumab is a humanized immunoglobulin monoclonal antibody directed against CD52, a glycoprotein expressed on circulating T and B lymphocytes and natural-killer cells (Rovelli et al., 2007). Side effects of alemtuzumab can include fever, chills, dizziness, muscle stiffness, nausea and vomiting, headache, diarrhea, rashes, tiredness, or dyspnea, along with a black box warning of developing serious, including fatal, cytopenias, infusion reactions, and infections. Another case report involving an infant, rather than an adult, who presented in a similar manner showed successful remission when treated with rituximab (Miloh et al., 2007).

Blood and Blood Vessels

Autoimmune hemolytic anemia, acquired aplastic anemia, pernicious anemia, autoimmune thrombocytopenia, temporal arteritis, antiphospholipid syndrome, vasculitides (Wegener's granulomatosis), cryoglobulinemia, and Behçet's disease are potentially lethal autoimmune diseases of the blood and blood vessels. A registry of 1,370 patients with systemic autoimmune diseases treated with biologic agents was analyzed by the Study Group on Autoimmune Diseases (GEAS) of the Spanish Society of Internal Medicine. These findings were compiled in the BIOGEAS project, a multicenter group that proposes general recommendations on the rational use of these new biotherapeutic agents in patients with systemic autoimmune diseases through an electronic distribution list. The BIOGEAS project originally was created based on the multicenter extension of the registry to GEAS. Treatment with rituximab correlated with a high therapeutic response in patients with antiphospholipid syndrome (92%) and cryoglobulinemia (8 %) (Ramos-Casals, Brito-Zerón, Muñoz, & Soto, 2008). Etanercept is a fully human, soluble fusion protein created by the linkage of two ligand-binding regions of TNF-receptor and the Fc portion of human IgG1. Side effects of etanercept can include itching, pain, swelling and redness at the site of injection, headache, dizziness, and nasal and throat irritation, along with a black box warning of developing serious infections leading to hospitalization or death. Etanercept correlated with a therapeutic response of 96% in Behçet's disease (Ramos-Casals et al., 2008). However, no benefit was noted in patients with Wegener's granulomatosis when treated with infliximab or etanercept in controlled trials (Ramos-Casals et al., 2008).

In a retrospective observational study involving 140 patients with autoimmune aplastic anemia treated with high-dose cyclophosphamide without stem cell rescue, the overall

response rate was 94%, with 44% of those patients remaining progression free with a median follow-up of 36 months. The overall actuarial and event-free survival across all diseases at 60 months was 91% and 21%, respectively (DeZern et al., 2011).

In a clinical trial involving 19 patients with steroid-refractory autoimmune hemolytic anemia and immune thrombocytopenic purpura (ITP), low-dose rituximab plus alemtuzumab was evaluated for safety and efficacy. Eleven patients had ITP and eight patients had autoimmune hemolytic anemia. Treatment with 10 mg of alemtuzumab subcutaneously on days 1 through 3, plus 100 mg of rituximab via IV weekly in four doses, was administered. The overall response rate was 100%, with complete response in 58%. The median response duration was 46 weeks (range = 16–89 weeks). Median follow-up was 70 weeks (range = 37–104 weeks). Most toxicity was grade 1 fever related to the first dose, and six patients developed infections. The combination of rituximab and alemtuzumab revealed an acceptable safety profile and remarkable clinical activity in these patients (Gómez-Almaguer et al., 2010).

In a randomized trial that investigated rituximab's efficacy in previously untreated adult patients with ITP with a platelet count of 20 x 10^9/L or less, 103 patients were randomly assigned to receive 40 mg dexamethasone per day for four days with or without 375 mg/m² rituximab weekly for four weeks. Sustained response of platelet count equal to or greater than 50 x 10^9/L at six months was noted in patients treated with dexamethasone plus rituximab when compared to those treated with dexamethasone alone. Although some patients showed increased incidences of grade 3–4 adverse events, the overall incidences of serious adverse events were similar in both treatment arms. Dexamethasone plus rituximab was found to be an effective salvage therapy in the majority of patients who were refractory to dexamethasone alone (Zaja et al., 2010).

Skin

Psoriasis, dermatitis herpetiformis, pemphigus vulgaris, and vitiligo are common integumentary diseases with autoimmune properties. A randomized study of 903 patients with moderate-to-severe psoriasis received subcutaneous injections of either 45 mg or 90 mg of ustekinumab (at weeks 0 and 4) or high-dose etanercept (50 mg twice weekly for 12 weeks). Ustekinumab is a human monoclonal antibody directed against interleukins 12 and 23, naturally occurring proteins that regulate the immune system and inflammatory disorders. Side effects of ustekinumab can include upper respiratory and other infections, hypersensitivity and anaphylactic reactions, headache, fatigue, increased risk of developing cancer, and reversible posterior leukoencephalopathy syndrome, a rare condition that affects the brain and can cause death. At least 75% improvement was observed in the psoriasis area-and-severity index (PASI) at week 12 in 68% of patients who received 45 mg of ustekinumab and 74% of patients who received 90 mg, as compared to 57% of those who received etanercept. Similarly, 65% of patients who received 45 mg of ustekinumab and 71% of patients who received 90 mg of ustekinumab had cleared or minimal disease as compared to 49% of those who received etanercept. Among patients who did not have a response to etanercept, 49% had at least 75% improvement in the PASI within 12 weeks after crossover to ustekinumab. The efficacy of ustekinumab at a dose of 45 mg or 90 mg was superior to that of high-dose etanercept over a 12-week period in patients with psoriasis (Griffiths et al., 2010).

About half of patients with chronic autoimmune urticaria (CAU) have an IgG autoantibody directed to the alpha-subunit of the high-affinity IgE receptor leading to cutaneous mast cell and basophil activation (Kaplan, Joseph, Maykut, Geba, & Zeldin, 2008). Twelve patients with CAU despite antihistamine therapy were treated with omalizumab. Omalizumab is a recombinant DNA-derived humanized IgG1-kappa monoclonal antibody that selectively binds to human immunoglobulin E, commonly involved with allergies when present in high amounts in the body. Side effects of omalizumab can include injection-site reactions, headache, pharyngitis and other respiratory infections, increased risk of developing cancer, and serum sickness, along with a black box warning of anaphylaxis presenting as bronchospasm, hypotension, syncope, urticaria, and/or angioedema of the throat or tongue. Seven patients achieved complete symptom resolution. The urticaria activity score (UAS) is a widely used patient-reported chronic idiopathic urticaria measure with a simple scoring system that captures the intensity of pruritis and the number of hives. In four patients, the mean UAS decreased, but urticaria persisted, whereas in another patient, no response was noted. The need for rescue medications was reduced significantly and quality of life improved (Kaplan et al., 2008).

Endocrine Glands

Type I diabetes, Graves' disease (GD), Hashimoto's thyroiditis, autoimmune oophoritis and orchitis, and autoimmune adrenal gland disease are all examples of autoimmune diseases affecting the endocrine glands. A prospective, controlled, nonrandomized study assessed the effect of rituximab in 20 patients with GD. Four patients who received rituximab remained in remission with a median follow-up of 705 days, whereas all patients who did not receive rituximab had relapsed by 393 days (El Fassi, Nielsen, Bonnema, Hasselbalch, & Hegedüs, 2007). Although treatment with rituximab induced a sustained remission, it did not lower autoantibody levels. In addition, because of the high cost of immune therapy, several other less expensive and proven therapies for uncomplicated GD, as well as for the other autoimmune endocrine diseases, exist and frequently are used instead.

The coexistence of MS with other autoimmune diseases has been reported. The hypothesis that MS coexists with other autoimmune diseases has been supported by the reported association of MS with type I diabetes mellitus and inflammatory disorders. Despite rare reports of associations between Hashimoto's thyroiditis and MS, an association between the two diseases is important for clinical and therapeutic aspects. The thyroid hormone levels of patients with MS being treated with IFN-beta and

Learn More About Autoimmune Diseases

The American Autoimmune Related Diseases Association provides a list of links to disease-specific and general autoimmune resources. To learn more, visit www.aarda.org/links.php.

alemtuzumab should be monitored, given that two confirmed patients with MS also fulfilled criteria for Hashimoto's thyroiditis in a study by Petek-Balci, Yayla, and Ozer (2005).

Type I diabetes rarely is treated with immunotherapy unless to delay disease progression. Several randomized phase II and III studies using anti-CD3 monoclonal antibodies thought to protect remaining beta cells in newly diagnosed type I diabetics have taken place in recent years, but have failed to pass primary endpoints of efficacy, resulting in pharmaceutical abandonment (Knol Publishing, 2011). Similar to autoimmune thyroid disease, other more proven and less expensive therapies exist to combat the symptoms rather than treat the cause. Significant findings from type I diabetes research remain elusive despite being a growing pandemic as well as one of the more heavily researched disease entities.

Musculoskeletal System

Rheumatoid arthritis (RA), systemic lupus erythematosus (SLE), scleroderma, sarcoidosis, polymyositis, polychrondritis, ankylosing spondylitis, and Sjögren's syndrome (SS) are life-altering and potentially fatal autoimmune diseases. Infliximab consistently has been proven effective in several clinical trials in treating patients with RA (Efthimiou & Markenson, 2005). A phase III, randomized, multicenter, double-blinded, placebo-controlled trial of infliximab in 428 patients with active disease despite methotrexate (MTX) treatment showed a marked reduction in the progression of the RA erosions and joint narrowing in the infliximab plus MTX treatment groups when compared with MTX alone one year later (Maini et al., 1999). MTX is an antimetabolite and antifolate chemotherapy drug that directly kills cells by inhibiting the metabolism of folate, an essential B vitamin used to synthesize DNA. Side effects of methotrexate can include mouth sores, nausea and vomiting, neutropenia, multiple organ toxicities, headache, drowsiness, itching, skin rashes, dizziness, and alopecia. Similarly, a multicenter, phase III, double-blinded, placebo-controlled trial involving 1,049 patients assessed the efficacy and safety of infliximab in combination with MTX versus MTX alone in the treatment of early RA. Seventy-six percent of patients in the combination arm had significant reduction in disability as measured by the health assessment questionnaire versus 65% in the MTX-only group (Efthimiou & Markenson, 2005; St. Clair et al., 2004).

According to GEAS findings from the BIOGEAS project, rituximab led to high rates of therapeutic responses in patients with SLE (90%) and SS (91%) (Ramos-Casals et al., 2008). That data review was extracted from 172 patients with SLE and 215 patients with SS. In addition, infliximab showed a therapeutic response in sarcoidosis (99% of 219 patients) and polychondritis (86% of 80 patients); however, no benefit was noted in patients with SS treated with infliximab or etanercept (Ramos-Casals et al., 2008).

Nine pediatric patients with systemic lupus erythematosus who also were diagnosed with either autoimmune thrombocytopenia or autoimmune hemolytic anemia were followed in a retrospective, single-center cohort study. All patients treated with rituximab remained in complete response at 24, 44, 84, and 100 weeks of follow-up, with only one patient having a hypersensitivity reaction and no one developing any serious infections (Kumar, Benseler, Kirby-Allen, & Silverman, 2009). The mechanism of B cell depletion therapy was credited as safe and efficacious in the resolution of pediatric SLE.

Implications for Practice

- Some traditional chemotherapeutic agents and many of the new biotherapies are being used successfully to slow, halt, and, in some cases, reverse autoimmune processes in patients with refractory disease.
- Many of these agents, particularly biotherapies, possess potentially dangerous side effects, including hypersensitvity reactions that range from mild to anaphylactic shock.
- All nurses need to be well informed about these agents, follow drug and institutional recommendations and guidelines, and be ready to act in case such events occur to avoid patient harm.

Conclusions

Autoimmune diseases continue to pose challenges for successful treatment because of their complex and poorly understood pathophysiologies. In addition, the science of immunology remains one of the more dynamic specialties. The potential exists to discover more new information each day concerning future and approved biotherapy medications than most other treatments for any other disease type. Interestingly, patients continue to be treated by healthcare professionals keenly focused on local signs or symptoms of an affected organ system rather than a systemic focus by an autoimmunologist. Patients and their families also are becoming more informed partners in their care, armed with valid but in some instances potentially incorrect information taken from the Internet. Improved outcomes and symptom management using these newer nontraditional therapies provide a great impetus for healthcare professionals to remain abreast of the advancements made to current treatment options.

Implications for Nursing

The field of oncology continues to change rapidly. Given that traditional chemotherapy and biotherapeutic agents are being used more frequently to treat patients with autoimmune diseases, nononcology nurses must continue to update their knowledge, refine their skills, and promote safe-handling practices. Conversely, oncology nurses may find themselves treating nononcology patients with chemotherapy or biotherapy. ONS offers a Treatment Basics Course, an abbreviated form of their 16-hour ONS Chemotherapy and Biotherapy course, that supports the national standard required to administer chemotherapy in oncology. The ONS Treatment Basics Course is a four-hour didactic course highlighting the minimally necessary knowledge tailored to nurses caring for the autoimmune population in a continuing education format. The course describes the use of antineoplastic agents in cancer and nonmalignant diseases, administration procedures such as extravasation management, handling and disposal of HDs using the proper personal protective equipment, patient

education, and symptom management. About 200 trainers located throughout the United States offer these classes, and they can be found at www.treatmentbasics.vc.ons.org.

Regardless of which specialty, proper education, training, and continual learning remain essential for all nurses (oncology and nononcology) to maintain their skills and perform competently in such a dynamic healthcare environment. With more and more potential HDs being successfully used to improve patients' lives outside of oncology, the risks of HD exposure and adverse effects diminishing patient safety also increase. Focused attention on reducing preventable adverse drug reactions or events such as anaphylaxis with a biologic agent or accidental staff exposure to a chemotherapy spill can be realized with the knowledge gained from attending one of the ONS courses discussed. A shared clinical practicum with an experienced ONS chemotherapy and biotherapy certified nurse also should ensue. However, individual institutions ultimately are responsible for determining their own requirements for assessing clinical competency.

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