Oncology clinicians administer monoclonal antibodies (MoAbs) as part of the armamentarium against cancer. Nurses are skilled in the management of general treatment-related symptoms and are knowledgeable regarding the care of patients receiving these therapies. New therapies require expanded knowledge bases regarding unique and selective side effects, such as those seen with targeted therapy agents.

Oncology clinicians administer monoclonal antibodies (MoAbs) as part of the armamentarium against cancer. Nurses are skilled in the management of general treatment-related symptoms and are knowledgeable regarding the care of patients receiving these therapies. New therapies require expanded knowledge bases regarding unique and selective side effects, such as those seen with targeted therapy agents.

In general, the overall incidence of hypersensitivity reactions (HSRs) to most chemotherapy treatments is 5%, but certain agents carry much higher risks.[1] As a potential adverse event, HSRs may occur with almost any anticancer agent and can range in severity from mild to severe or even result in patient fatality. These reactions may present as acute or delayed, depending on the specific agent or class.[2] Although oncology nurses may be experienced in the management of HSRs with traditional chemotherapy agents, such as taxanes or platinum agents, certain MoAbs are associated with significant risks of HSRs as well. Specific MoAbs can result in immediate HSRs, which usually occur during the first infusion. As these therapies are becoming increasingly important in our treatments for cancer, awareness of the potential for HSRs with MoAbs and of the strategies used to manage them is vital for the practicing oncology professional.

Scope of the Problem

Reactions may be associated with the immunogenicity of the mouse protein of the drug, as in the case of MoAbs (see Figure 1). Although the immunoconjugates are used less frequently, the six unconjugated MoAbs are an integral part of therapies used to treat common cancers.[3] Monoclonal antibodies have induced fatal reactions in rituximab (Rituxan), rare instances have occurred with trastuzumab (Herceptin; some noted up to 24 hours after the dose was given prompting a label change in 2000), and less than 1% of the doses associated with bevacizumab (Avastin) were noted to be fatal in the clinical trials.[4] Cetuximab (Erbitux) has produced fatal infusion reactions in less than 0.1% of patients. Panitumumab (Vectibix) has not produced a fatal infusion reaction as of this writing; however, a fatal case of angioedema occurring several days after drug administration has recently been reported (personal communication, Dr. Volker Wagner, Amgen, Inc).

Because infusion reactions can be fatal for some patients, it is not surprising that oncology nurses are frightened of having patients experience one.[5] Oncology nurses surveyed at the 2005 annual meeting of the Oncology Nursing Society (ONS) depicts attitudes and beliefs of oncology nurses and
how they experience infusion reactions.[6] This is the first time oncology nurses have been assessed for the impact of infusion reactions on patients and clinicians in inpatient and outpatient settings. The results show that infusion reactions are common, that rituximab and paclitaxel were the most common cause of infusion reactions, and that the reactions are emotionally difficult for both staff and patients. The authors point out that 52% of the respondents felt that infusion reactions were very draining and frightening, and that 88% of outpatient nurses and 62% of inpatient nurses felt that reactions were frightening to other patients. Additionally, 42% of the nurses surveyed felt that physicians do not adequately inform patients about the risks of infusion reactions, which points out the importance of patient education regarding potential for HSRs with cancer therapies. The study authors recommended that further awareness of infusion reaction management and education of patients and clinicians are needed.[6]

Schwartzberg et al conducted a retrospective chart review of severe infusion reactions with commonly administered monoclonal antibodies.[7] This review shows that most reactions occur during the first cycle of therapy and that many of the patients (22%) needed hospitalization related to the event, with some patients subsequently discontinuing treatment of cetuximab because of their reactions.

**TABLE 1**

<table>
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<tr>
<th>Premedications and Black Box Warnings for Monoclonal Antibodies</th>
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<tbody>
<tr>
<td>Drug Name</td>
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<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Rituximab</td>
</tr>
<tr>
<td>Cetuximab</td>
</tr>
<tr>
<td>Bevacizumab</td>
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</table>

It is also interesting to note that although patients received pretreatment, many still had HSRs after or during infusion. Although the majority of reactions were limited to patients receiving rituximab and cetuximab (chimeric antibodies), some patients reacted to bevacizumab, a humanized and fairly well-tolerated MoAb. Few of these patients (8%) received test doses to predict HSRs. The hospitalized patients usually required oxygen, steroids, fluid resuscitation, and/or antihistamine therapy, with some receiving epinephrine during the reactions or H2 blockers.[7] The researchers concluded that these events are challenging for both patients and practices, with cost of hospitalization substantial, and recommended that clinical pathways and directives would benefit clinicians in preparing a planned approach to HSRs. These strategies could be used to help identify patients at higher risk for HSR and to instruct clinical staff in the optimal approach to the management of patients with infusion reactions or HSR.

**Strategies for Prevention of Hypersensitivity Reactions**

**TABLE 2**

<table>
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<tr>
<th>Elements of Baseline Comprehensive Assessment</th>
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<tbody>
<tr>
<td>Patient characteristics</td>
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<tr>
<td>Personal history</td>
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<tr>
<td>Personal history of drug allergy</td>
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<tr>
<td>Personal history of anaphylaxis</td>
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Factors that determine the development and severity of anaphylaxis include the antigen’s route of entry, the amount of antigen introduced, the rate of absorption for the antigen, and the individual’s degree of hypersensitivity to the drug (Table 2).[8] Strategies to reduce or prevent HSRs include obtaining a comprehensive allergy history, the use of premedication, skin testing, desensitization, alteration of infusion rates, and knowledge of specific patient groups at risk—including awareness of the potential for geographic differences in the allergic response rate for specific medications,
including MoAbs.[8] When conducting patient education sessions prior to administration of drug therapy, nurses should be cognizant of general allergy history and increased risk for patients scheduled to receive cetuximab in certain geographic areas, including North Carolina and Tennessee.[9] Data have also shown that certain risk factors with rituximab may predict higher HSRs, including age, gender, and primary tumor type.[4]

Premedications are recommended with MoAbs as well as chemotherapy agents. Although there is no evidenced-based standard for a premedication protocol, these medications often include the use of $H_1$ blockers, such as diphenhydramine, acetaminophen, and less frequently, corticosteroids, depending on the agent (Table 1).[8,10] Most MoAbs contain a black box warning for infusion-related reactions, with the exception of bevacizumab. Premedication is recommended for most agents, although it is not necessary with bevacizumab, panitumumab, or trastuzumab.

**Assessment and Management of HSR**

The National Cancer Institute (NCI) Common Terminology Criteria for Adverse Events (CTCAE) v3.0 describes HSRs in terms of both an allergic reaction and the cytokine release syndrome more specific to MoAb reactions (see Table 2 in the article by Cmelak and colleagues that begins on page 18 of this supplement). The symptoms seen with cytokine release syndrome are related to the elevated levels of cytokines and release of histamine as tumor antigen-expressing cells are damaged.[8] There are a myriad of symptoms that could indicate a possible acute infusion reaction. Cytokine release syndrome can produce fevers, chills, and rigor, as well as those symptoms typically seen with acute hypersensitivity reactions.[8]

Hypersensitivity symptoms may include pruritus, urticaria, rigors, chills, headache, arthralgias or myalgias, pain at tumor site, gastrointestinal symptoms (including nausea), or respiratory symptoms (ranging from cough to dyspnea or bronchospasm).[10] Patients may describe a feeling of impending doom.[8] As edema of the upper or lower airway proceeds, patients may develop stridor or wheezing.[11] Cardiovascular symptoms may include changes in blood pressure or tachycardia. As vasodilation occurs, hypovolemia ensues, with increased capillary permeability producing intravascular collapse.

There are several existing guidelines for the management of HSRs (Figure 2). The ONS has established guidelines that are available as part of the ONS Chemotherapy and Biotherapy Guidelines and Recommendations for Practice.[12] The ONS recommends that clinical management of localized HSRs should entail patient observation and evaluation of symptoms, such as urticaria. Pharmacologic management may include the administration of diphenhydramine, cimetidine, and/or corticosteroids as ordered by the physician or according to standing protocols. Vital signs should be monitored at least every 15 minutes for 1 hour as deemed necessary. Thorough documentation of the episode, including any therapies administered, should be completed according to the policy of the institution.

The ONS guidelines for the management of hypersensitivity and anaphylaxis calls for the cessation of chemotherapy infusion immediately, while maintaining an IV line with normal saline or other appropriate solution. The nurse should stay with the patient while another staff member notifies the physician and emergency staff if needed. If the reaction occurs outside the hospital setting, the local emergency medical service should be notified. The patient should be placed in a supine position if possible and vital signs monitored every 2 minutes until the patient is stable, every 5 minutes for 30 minutes more, and every 15 minutes thereafter. Oxygen should be administered if needed, and the nurse should anticipate the need for CPR.[12] Emergency medications may include epinephrine,
corticosteroids, and H1 and H2 blocker agents. Because managing a hypersensitivity reaction can be frightening to staff, patients, and family members, nurses should provide emotional support. Accurate documentation of the event is essential.

The American Heart Association (AHA) has published guidelines for management of anaphylaxis and prevention of cardiopulmonary arrest. In general, the guidelines call for oxygen at a high flow rate, administration of corticosteroids, H1 and H2 blocker agents. The AHA guidelines discuss the role of corticosteroids in the management of acute reactions, noting that this class of drugs is also important in the management of delayed symptoms (the biphasic response), which can occur 4 to 6 hours after the initial HSR.

For moderate and severe reactions, the recommendation is for intramuscular epinephrine (preferred over the sometimes erratic absorption of subcutaneous administration). The AHA also notes that patients taking beta-blocker medications have a higher incidence and severity of anaphylaxis and possible paradoxical response to epinephrine and recommend the consideration of glucagon (GlucaGen) and ipratropium bromide for those patients. Aggressive fluid resuscitation is necessary with hypotension. Other possible considerations for pharmacologic treatment might be vasopressin for severely hypotensive patients, atropine sulfate (Sal-Tropine) for patients with relative or severe bradycardia, or glucagon for patients not responsive to epinephrine.

Rechallenge or retreatment with an agent after nonsevere or non–lifethreatening HSRs may be attempted, but requires a careful assessment of the potential risk-benefit ratio prior to therapy. For some patients, pretreatment with premedication regimens may be used. Some therapies involve the use of desensitization or skin testing. With specific MoAb therapies, such as rituximab, alteration of infusion rates has been useful in reducing reactions. Rechallenge after severe reactions is not recommended, and it is advisable to conduct rechallenge administrations in settings where optimal administration support is present, such as inpatient settings.

Established Clinical Pathways for Management of HSRs

The importance of established clinical pathways or protocols for the management of HSRs cannot be overestimated. Standardized order sets can ensure clinician response and direct the medical management of the patient in an orderly fashion. Oncology nurses should know the individual drugs with higher risk for HSRs. If no standing protocol exists in an institution, nurses should advocate for one.

Strategies to bolster knowledge and improve accurate responses to HSRs include having resuscitation protocols or algorithms printed on laminated cards available above the medicine cart or for use at the patient’s bedside. Mock HSR drills can educate staff and help ensure the knowledge base and the promotion of comfort levels for appropriate responses. Nurses practicing in outpatient settings may be required to call emergency medical services teams and staff should be familiar with protocols to contact these response teams.

Prompt recognition of the signs and symptoms of HSRs is crucial for early intervention and optimal patient outcome. Oncology nurses should be assessing patients for heightened risk with a thorough baseline evaluation prior to drug administration. Emergency kits or anaphylaxis drug kits should be present or close by during drug delivery. Knowledge of emergency drug action is necessary and nurses should have a comfort level in the administration of emergency agents and cardiopulmonary resuscitation if needed. Rarely, patients may suffer from a delayed or biphasic HSR in which symptoms may return hours after the initial event. Rechallenge may occur in some treatment settings, depending on the severity of the reaction and perceived clinical need for the drug. Oncology nurses should understand the strategies employed in patient rechallenge, including the role of drug titration protocols and skin testing.

Conclusion

Oncology nurses should be aware of the risk for HSRs. Knowledge of the appropriate emergency response is paramount. Severe hypersensitivity reactions are not common, but can be distressing to both nurses and patients. Some infusion reactions can be fatal.

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