



Pharmacology Update

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Practical Considerations in Administering Intravenous Medications

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Novel biopharmaceutical agents that require intravenous (IV) administration are currently in development or available for the treatment of many neurological conditions, including multiple sclerosis (MS). The use of these medications has the potential to change the course of disease management. Hence, neurology nurses and other caregivers may be called upon to administer a higher number of infusions to MS patients than they have in the recent past.

Historically, infusion nurses were responsible for the administration of IV treatments (e.g., methylprednisolone, mitoxantrone) to patients with MS in stand-alone infusion clinics, hematology and oncology offices, or hospitals. The use of these medications has generally been limited to patients needing short-term management of MS relapses (with methylprednisolone) or to patients with progressive MS (with chemotherapy agents, "pulse" corticosteroid protocols, IV immunoglobulin). With the development of IV therapies for the long-term treatment of patients with MS, nurses who care for patients in outpatient settings will most likely need to become acquainted with and fully prepared to administer IV biopharmaceuticals in the neurology clinic. This article provides an

update on practical considerations in delivering IV treatment in the outpatient setting through a short peripheral catheter.

Of all vascular access devices, peripheral venous catheters are the most frequently used (Centers for Disease Control and Prevention [CDC], 2002). The incidence of significant local or bloodstream infection associated with peripheral venous catheters is low; the majority of serious catheter-related infections are associated with centrally placed catheters (CDC). The Infusion Nurses Society's (INS) standards of practice state that therapies not appropriate for short peripheral catheters include solutions or medications with a pH <5 or >9 and solutions or medications with osmolarity >600 mOsm/L (INS, 2006). Numerous other factors are involved in assessing vascular access needs. A peripheral catheter may not be the best choice for some patients; for these patients, some other type of catheter may be more appropriate.

Preparing for Infusion Delivery in the Clinic Setting

Table 1 lists the equipment and supplies needed to establish IV infusion capabilities in an outpatient clinic and provide supportive care. In addition, a system for maintaining complete, accurate records of drug administration is essential (Hankins, Lonsway, Hedrick, & Perdue, 2001). During each visit, the patient's medical history and allergies should be reviewed, and data

should be updated in the medical record. The patient's response to all interventions, including venipuncture and drug infusion, must also be recorded. It is important to document the types of fluids or medications infused through the catheter, including the infusion rate, dose, and diluent; the type, length, and size (gauge) of the catheter; the date and time of the procedure; the number and location of attempts made; and the final, successful site (Millam & Hadaway, 2003). Other required documents include a pre-discharge assessment, a Health Insurance Portability and Accountability Act notice, a patient rights-and-responsibilities form, and a Medicare disclaimer. An insurance benefit authorization and an authorization to release personal health information may also be required (Hankins et al.).

Aseptic Technique and Hand Hygiene

Nurses and other healthcare professionals who compound IV medications must use proper procedure, adhering to published guidelines on aseptic technique to avoid contamination. Both the American Society of Health-System Pharmacists (ASHP) and the United States Pharmacopeia Convention (USPC) have published guidelines on compounding sterile preparations (ASHP, 2000; USPC, 2003).

Accidentally introduced microbes have less time to grow to pathological levels if infused drugs are prepared

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Table 1. Intravenous Infusion Equipment and Supplies

Step	Equipment and Supplies
Compounding or mixing (Performed in a pharmacy or appropriately equipped workspace)	Refrigerator Clean room with laminar flow hood and associated personal protective equipment Gloves Normal saline or 5%-dextrose-in-water (NS/D ₅ W) bags Sterile needles Sterile syringes Sharps containers
Infusion	IV pole Disposable tourniquet for single-patient use Skin antiseptic agents Small-gauge catheters (22 or 24 gauge) Manufactured catheter stabilization device (e.g., StatLock®, Venetec International, Inc.) or sterile tape Dressing (gauze or transparent membrane dressing) Administration sets Infusion pumps (depending on medication) Bathroom access, if necessary
Supportive care	Medication and supplies to manage complications: Antihistamines (e.g., diphenhydramine) Corticosteroids (e.g., hydrocortisone) Epinephrine Pressors Defibrillator Endotracheal tubes and intubation equipment Oxygen

preparation before catheter insertion. The CDC also prefers 2% chlorhexidine for skin preparation; however, you may also use 70% alcohol, tincture of iodine, or an iodophor. Antiseptics must remain on the insertion site and be allowed to air dry before catheter insertion. If povidone iodine is used, allow it to remain on the skin for at least 2 minutes before catheter insertion. Do not apply organic solvents such as acetone or ether to the skin before catheter insertion (CDC, 2002). To maintain sterility, ensure that the insertion site is not palpated after the skin has been cleaned. Implementation of these guidelines reduces the frequency of venous catheter complications.

In August 2001, the Needlestick Safety and Prevention Act became effective (Rosenthal, 2001). As a result, manufacturers of IV devices have incorporated safety devices such as self-sheathing stylets on peripheral IV catheters and needleless systems on IV tubing connections (Rosenthal). Over-the-needle safety catheters include active or passive safety mechanisms—active safety mechanisms require activation by the user, and passive mechanisms are automatically triggered after the stylet has been removed (Millam & Hadaway, 2003).

Sterile gloves are not required for appropriate aseptic technique; however, the CDC recommends the use of a new pair of disposable nonsterile gloves and a no-touch technique during the insertion of peripheral venous catheters. The Occupational Safety and Health Administration requires the use of gloves as a standard precaution for the prevention of exposure to bloodborne pathogens (CDC, 2002).

immediately before administration and infused over a short period of time. Guidelines that address new requirements for compounding sterile drug preparations in physicians' offices and other facilities state that preparations compounded from sterile commercial drugs using sterile commercial devices are considered to be at low risk of contamination when the compounding does not involve pooling doses, complex or multiple manipulations, a time-intensive process, broad-spectrum bacteriostatic agents, admixing with nonsterile ingredients, or administration over several days via an implanted or externally worn device (USPC, 2003). Medications typically used for the treatment of MS are associated with a low risk of microbial contamination. Compounding these medications should take place using an International Organization for Standardization (ISO) Class-5

laminar airflow workbench or hood located in an ISO Class-8 buffer room with an ante area. If a sterility test is not performed, the storage periods for low-risk compounded sterile products should not exceed 48 hours at controlled room temperature, 14 days at 2°–8° F, or 45 days at ≤–20° F (USPC).

Catheter Insertion

Aseptic techniques for catheter insertion are described in the CDC's guidelines (CDC, 2002). These guidelines were developed for practitioners who insert catheters or are responsible for surveillance and control of infections in the hospital, outpatient, or home setting (CDC).

Infection control techniques for the placement of short peripheral catheters include good hand hygiene. In July 2000, the Food and Drug Administration (FDA) approved a 2% tincture of chlorhexidine for skin

Short peripheral catheters are usually inserted in the veins of the forearm or hand; hand veins should be avoided if the medication is a vesicant, which can cause tissue damage. When selecting an injection site, several factors should be considered: the patient's medical history, age, and size; the condition of the patient's veins; and the skill level of the nurse. Hand veins should not be used for elderly patients who have lost subcutaneous tissue surrounding the veins. In patients who are obese, it may be difficult to locate the veins of the forearm. Veins below the area of previous IV infiltration and those below a phlebotic area should

be avoided, as should areas that are sclerosed or thrombosed, inflamed, diseased, bruised, or broken down. Veins in an arm affected by mastectomy, edema, blood clot, or infection should not be used (Millam & Hadaway, 2003). The venipuncture procedure is listed in Table 2.

Common Problems Encountered During Venipuncture

Improper tourniquet use can cause difficulty during venipuncture (Millam & Hadaway, 2003). It is important to avoid placing the tourniquet too high or too low and to ensure it is not tied too tightly or too loosely. Failing to promptly release the tour-

niquet after inserting the cannula may increase intravascular pressure, causing bleeding outside of the vein. Improper technique can also cause problems. Nurses who lack confidence may approach the vein with a stop-and-start technique, which can injure veins and cause bruising. Other difficulties may arise if the vein is not stretched adequately (i.e., the stylet may push the vein aside) or the cannula is not inserted correctly. An improper insertion angle may result in failure to penetrate the vein, with the cannula on top of or below the vein. Diminished blood return is a sign of cannula penetration through the opposite wall of the vein. Blood may suddenly backflow when the catheter is retracted.

Other possible reasons for a lack of backflow include severe vasospasm or an occlusion (i.e., blood clot or lipid plug) of the cannula. The reason for lack of backflow may be not be immediately apparent. If the cannula will not move freely, it may be embedded in fascia or muscle because it was inserted too deeply (i.e., below the vein). If this happens, the patient may complain of severe discomfort and the risk of nerve injury is increased. Burning, tingling, or a shocklike sensation during or after venipuncture may indicate nerve irritation or compression, and the catheter should be removed immediately.

Infusion

You can perform most infusions by standard techniques such as dripping directly through a solution set or using an infusion pump. Write the date and time on a time strip and tape it to the infusate container (Hankins et al., 2001).

Table 2. Venipuncture Preparation and Procedure

Preparation	<ol style="list-style-type: none"> 1. Perform hand hygiene with either alcohol-based gels or antimicrobial soap and water. Nurses who perform invasive procedures should wear clean gloves and should not have artificial or long fingernails. 2. Gather equipment. 3. Attach administration set to fluid container and prime set with fluid. Do not remove protective cover on end of set until ready to connect it to catheter. 4. Place patient in the supine position. Apply tourniquet. 5. Palpate along length of vein with index finger of nondominant hand. Always palpate with same finger of same hand to develop ability to feel veins easily. Vein should have a spongy feel, should be resilient and elastic, and should bounce after compression. 6. Prepare skin with 2% chlorhexidine using a back-and-forth scrubbing motion for a minimum of 30 s; allow to air dry for 30 s. 7. Do not repalpate or touch area after cleansing skin.
Procedure	<ol style="list-style-type: none"> 1. Remove protective cover from needle. 2. Position needle with bevel up in line with vein, and grasp patient's arm below entry point with nondominant hand. 3. Place thumb of nondominant hand 1 inch below entry site, and pull skin taut toward hand. 4. Pierce skin at a 10°–15° angle. 5. Advance needle to pierce vein, and observe for flashback of blood. 6. Advance a small length (1/8 inch) into vein to ensure that needle and catheter are inside vein lumen. 7. Push catheter off needle stylet and into vein. 8. Activate safety mechanism on catheter. 9. Attach primed administration set and adjust infusion rate. 10. Observe site for signs and symptoms of infiltration. 11. Secure and dress site. 12. If needle is withdrawn above skin surface, start over with a different needle. 13. <i>Do not</i> reinsert needle stylet into catheter. 14. <i>Do not</i> use one catheter for more than one attempt. 15. <i>Do not</i> allow more than two attempts per nurse.

Table 3. Common Symptoms of Infusion and Hypersensitivity Reactions

Type of Reaction	Symptoms	
Infusion (occurs within 2 hr of infusion)	Headache	
	Dizziness	
	Nausea	
	Fatigue	
	Rash or pruritus	
Hypersensitivity		
	Immediate (occurs within 24 hr of infusion)	Hives
		Flushing
		Vomiting
		Dyspnea
		Chest pain
		Throat swelling
		Hypotension/hypertension
		Rigors
		Delayed (i.e., serum sickness; occurs within 7–10 days of infusion)
	Arthritis	
	Nephritis	
	Neuritis	
	Edema	
	Chest pain	
	Urticarial, papular, or purpuric rash	

Adhere to the manufacturer's recommendations regarding the use of filters, inspection of solution for appropriate appearance, compatibility of solutions and equipment, administration rate, and duration of administration (Weinstein, 2001). Be aware of the safety precautions, potential side effects, and warnings associated with the drug. Monitor the patient during the infusion and for 1 hour after the infusion, unless a longer observation period is directed by the drug manufacturer. Monitoring should include vital signs and inspection of the infusion site for complications with venous access, as well as communication regarding any signs or symptoms of

infusion reactions or hypersensitivity reactions. After the infusion is complete, remove the dressing and catheter, tape a dry gauze pad over the site, and apply pressure for 1–2 minutes (Millam & Hadaway, 2003).

Preventing and Managing Complications of Venous Access

Possible complications associated with short peripheral venous access include infiltration of infused fluids (non-vesicants) into the surrounding tissue, extravasation of vesicant medications or blood into the surrounding tissue, and phlebitis. The classic signs and symptoms of infiltration are edema, swelling, blanching and coolness, and temperature changes (Hadaway, 2002). Patients may report pain or discomfort or a feeling of tightness around the site. However, not all patients experience discomfort. If infiltration is suspected, carefully assess both arms and compare them for differences. Edema also can be caused by conditions such as heart failure, renal failure, or the presence of an arterio-venous fistula. Ensure that the IV catheter is patent by

flushing it with a saline-filled syringe and aspirating for a brisk blood return. Even when blood can be drawn from the catheter, infiltration may occur under certain circumstances. Mechanical forces that displace the catheter, blood flow obstructions around or through the catheter, and the inflammatory process all can cause infiltration (Hadaway).

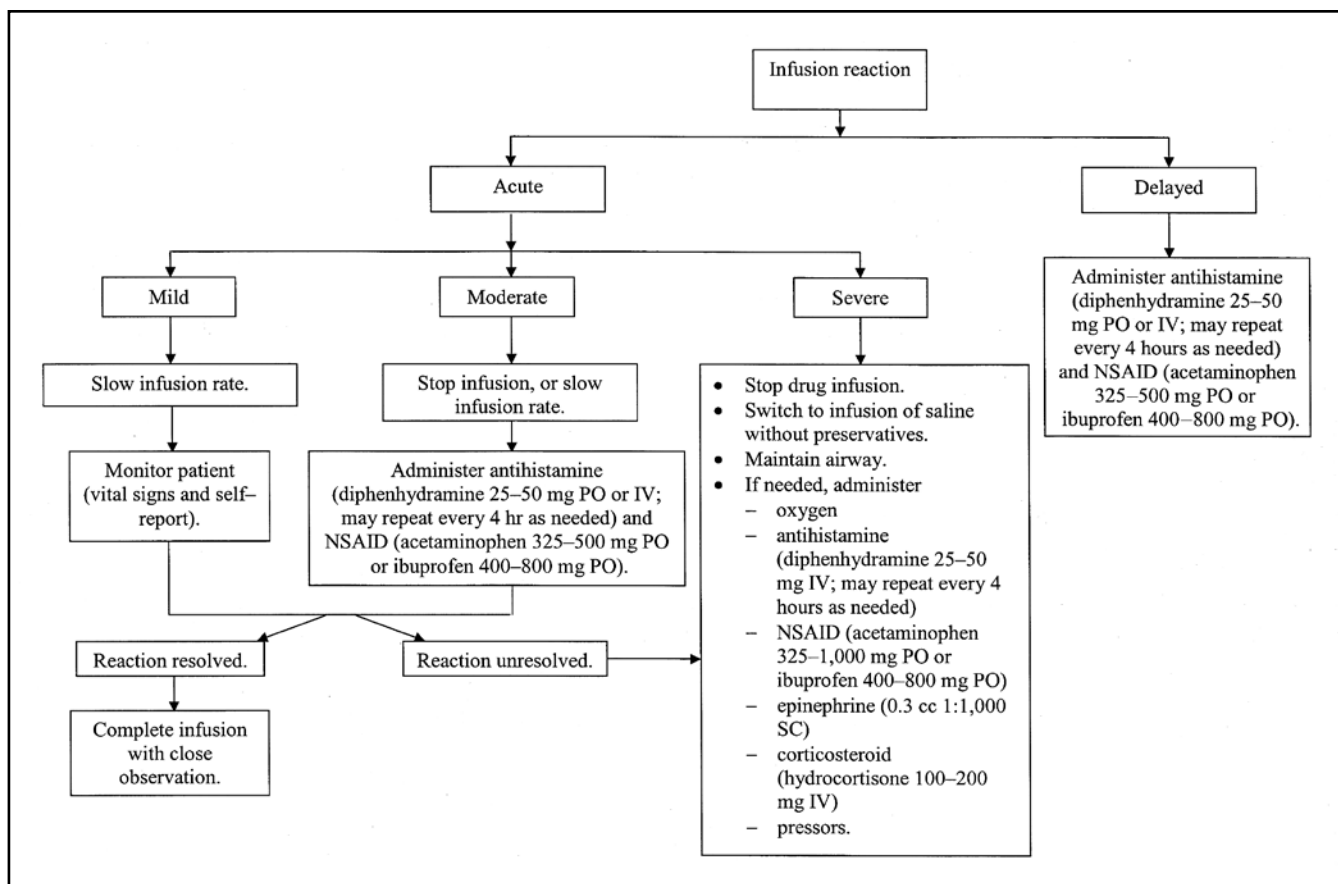
Phlebitis is manifested as warmth, tenderness, erythema, induration, or palpable venous cord (CDC, 2002). The risk of phlebitis increases as the duration of catheter placement increases. It may occur during or after the infusion (Grüne et al., 2004). An acceptable rate of phlebitis prevalence among patients is ≤5% (INS, 2000).

Factors that affect phlebitis include the pH and osmolarity of medications administered, dwell time, type of catheter, location of the access site (veins below areas of previous IV infiltration or below a phlebotic area, sclerosed or thrombosed veins, and areas of inflammation, disease, bruising, or breakdown should be avoided), as well as patient factors including age and gender, circulatory function, and skill of the nurse initiating therapy (Maki & Ringer, 1991; Palefski & Stoddard, 2001). Proper education and training of infusion personnel can reduce the risk of vascular-catheter infection (Palefski & Stoddard).

Managing Potential Infusion Reactions

Infusion reactions (nonimmune-mediated reactions during the infusion procedure itself) and hypersensitivity reactions (immune-mediated reactions) significant enough to result in clinical manifestations may also occur. These reactions form a continuum ranging from mild localized swelling or pruritus to severe generalized reactions with cardiorespiratory compromise (see Table 3). Infusion reactions can be managed by administering oral acetaminophen (325–1,000 mg) or oral or IV diphenhydramine (25–50 mg), both before subsequent infusions, or by slowing the infusion rate.

Hypersensitivity reactions are classified as either immediate or delayed (i.e., serum sickness; Fig 1, Table 3). These reactions can be caused by immune-mediated responses to items used during the procedure (e.g., latex tourniquets, packaging, rubber-stoppered vials, injection ports), the medication, or other substances added to the medication to ensure stability. Patients should be educated about potential reactions, and nurses should instruct patients to report any reactions to the physician or nurse immediately. As directed by the physician, the nurse may be asked to administer treatment for a hypersensitivity reaction.



Note. IV = intravenously; NSAID = nonsteroidal antiinflammatory drug; PO = orally; SC = subcutaneously.

Fig 1. Treatment algorithm for hypersensitivity reactions during intravenous treatment

Treatment guidelines for hypersensitivity reactions vary according to reaction type (immediate or delayed) and severity (Fig 1). For immediate hypersensitivity reactions, one option is to stop administration of the drug immediately and institute proper supportive measures, if needed (e.g., oxygen, epinephrine, antihistamine, corticosteroids, IV fluids, pressors; Project Team of the Resuscitation Council, 2001). For some medications, slowing the infusion rate until the reaction is resolved is an option.

Monitoring and Process Improvement

For compounding sterile products, quality assurance practices include routine disinfection and air quality testing; visual confirmation that compounding personnel are using proper personal-protection equip-

ment; thorough review of all orders and packaged ingredients; and visual inspection of the compounded sterile products for particulate matter, accurate labeling, and secure containment with no leakage (USPC, 2003).

Facilities should track venous access complications, identify the conditions associated with the complications, and institute procedures to address them, as a means of process improvement. For example, one facility instituted monitoring of former cannulation sites for 48 hours postinfusion because of the occurrence of postinfusion phlebitis, and the facility plans to develop a discharge sheet outlining the signs and symptoms of postinfusion phlebitis and how to respond, which will be given to infusion patients at discharge (White, 2001). Systemic hypersensitivity reactions should be tracked and reported to the FDA and the drug manufacturer.

Conclusions

Because of the development of new IV biopharmaceuticals agents for the long-term treatment of MS, nurses who care for patients with MS may be responsible for administering IV medications in the outpatient setting. It may be necessary to review procedures related to sterile and aseptic techniques and safety, which are pertinent to successful IV medication administration. Important skills include those related to the proper use of sterile technique and venipuncture procedure. Knowledge in these areas will provide neurology nurses with the confidence and ability to administer IV treatments with more ease.

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