Infusion Therapy

CLPNA Self-Study Course
2018
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Module 1: Key Concepts of Infusion Therapy

Introduction

This section of the course lays out the background knowledge that is required to support the LPN in working with infusion therapies. Thus, it refers to the regulatory requirements, the employers’ policies, and the need for knowledge of anatomy and physiology related to intravenous infusions in all their forms. We will also briefly mention the various uses for intravenous infusions that will be discussed more fully later in this course. The procedure for initiation of intravenous infusions is beyond the scope of this course and therefore will not be discussed here.

Outcomes

By the end of this module the LPN will be able to

- review the LPN’s scope of practice in Alberta with regard to infusion therapies;
- identify employer policies that direct LPN practice in infusion therapy;
- describe the anatomy and physiology of the circulatory system related to intravenous infusion therapies;
- state the purposes of IV infusion therapies;
- compare and contrast intracellular and extracellular fluid makeup;
- discuss the importance of interstitial fluid; and
- state the types and uses of infusion therapies used in client treatment and care.

Regulation

The scope of LPNs’ practice in the province of Alberta is established by the College of Licensed Practical Nurses of Alberta (CLPNA). Section V of the Competency Profile for Licensed Practical Nurses in Alberta indicates the extent of this scope with regard to intravenous infusion therapy. As a professional, it is required that LPNs recognize their competency and undertake additional education as directed by the restricted activities regulations in the Health Professions Act before engaging in this practice. This course, which is intended to provide a review of infusion therapy, is only one aspect of education that can assist LPNs in meeting the competencies. CLPNA and employers may require additional theory and practice in caring for clients who have peripheral infusions, total parenteral nutrition, or centrally placed lines before the LPN is considered competent.

Review CLPNA’s Competency Profile to understand scope of practice and restricted activities related to infusion therapy.
Review of Anatomy and Physiology Related to Intravenous (IV) Infusion Therapy

To be able to practice IV infusion therapy safely, the LPN needs to have a sound knowledge base in the anatomy and physiology of pulmonary and systemic circulation and the structures of the circulatory system. The systemic circulation consists of the arterial and venous systems. The venous system carries blood back to the vena cava and the right atrium of the heart from the capillary beds. The blood travels to the right ventricle of the heart, where it flows through the pulmonary artery to the lungs. The lungs oxygenate the blood, and it flows via the left atrium to the left ventricle, which pumps the blood to the aorta and all parts of the body through the arteries.³

![Figure 1. Blood flow in the heart. Image from Sunshineconnelly (CC BY 3.0).](image)

Knowledge of vein-wall anatomy and physiology is necessary for understanding the potential complications of IV therapy. As indicated in the online reading, the vein wall consists of three layers, and each has very specific characteristics and considerations involved in the introduction of IV catheters and the administration of IV fluids. In implementing or monitoring IV infusions, it is essential to know the location of the blood vessels and their relationship to the circulatory system in general. The blood vessels of the upper extremities are discussed and shown in Figure 2.
Veins Draining the Upper Limbs

The digital veins in the fingers come together in the hand to form the palmar venous arches [see Figure 2]. From here, the veins come together to form the radial vein, the ulnar vein, and the median antebrachial vein. The radial vein and the ulnar vein parallel the bones of the forearm and join together at the antebrachium to form the brachial vein, a deep vein that flows into the axillary vein in the brachium.

The median antebrachial vein parallels the ulnar vein, is more medial in location, and joins the basilic vein in the forearm. As the basilic vein reaches the antecubital region, it gives off a branch called the median cubital vein that crosses at an angle to join the cephalic vein. The median cubital vein is the most common site for drawing venous blood in humans. The basilic vein continues through the arm medially and superficially to the axillary vein.

The cephalic vein begins in the antebrachium and drains blood from the superficial surface of the arm into the axillary vein. It is extremely superficial and easily seen along the surface of the biceps brachii muscle in individuals with good muscle tone and in those without excessive subcutaneous adipose tissue in the arms.

The subscapular vein drains blood from the subscapular region and joins the cephalic vein to form the axillary vein. As it passes through the body wall and enters the thorax, the axillary vein becomes the subclavian vein.4

Since not all intravenous infusions are inserted peripherally, it is important for the LPN to know the anatomy and physiology of the circulatory system for all possible sites.

Figure 2. Thoracic upper limb veins. Image from OpenStax College (CC BY 3.0).

All these blood vessels can be seen in Figure 2. Take some time to review their location.

As the choice of sites is discussed, refer to Figure 2 above for peripheral infusions and to Figure 3 below to identify the locations of central infusion sites and their relationships to the major veins in the body.

The choice of site for the placement of an IV is important and is often determined by the age of the client, the urgency of the need for fluid and medication administration, and the skill of the practitioner in initiating an IV. Infusion therapy suggests that we start with veins that are located on the hand and then move up the arm. It is important, if the situation allows, to ask the client if they have a preference as to which hand to use when initiating the IV, as some people prefer not to tie down their dominant hand during therapy.
In some situations, there will be no choice. Anesthesia may need to have an IV in the left hand because access to the right side will be limited in the operating room, for example. The choice of sites is also dictated by the type and duration of therapy. If the client is receiving fluids for hydration and antibiotics, a larger vein might be best. If the site is for emergency access and no fluid will be infused, a smaller site may be fine. If blood or blood products will be required, a larger vein is needed.

In addition to the choice of vein, the size of the IV cathlon or catheter must be considered. Each IV cathlon has a specific interior diameter and associated flow rate. The employer’s policies and procedures may specify, for example, that a 20-gauge cathlon is the minimum size for blood administration, as this size of cathlon does not damage the red cells as it moves from the tubing into the cathlon and vein. The information for interior diameter and flow rate are found on the packaging of all brands of IV cathlon.

Veins of the extremities are designated as peripheral locations and are ordinarily the only sites used by nurses. Because they are relatively safe and easy to enter, arm veins are most commonly used. The metacarpal, cephalic, basilic, and median veins and their branches are recommended sites because of their size and ease of access. Central veins commonly used by physicians include the subclavian and internal jugular veins. It is possible to gain access to (or cannulate) these larger vessels even when peripheral sites have collapsed. Ideally, both arms and hands are carefully inspected before a specific venipuncture site that does not interfere with mobility is chosen. For this reason, the antecubital fossa is avoided, except as a last resort.5

Central venous access device sites include the subclavian vein or the jugular vein, where the tip of the catheter is positioned in the superior vena cava and, in some cases, in the right atrium6 (see Figure 4 below). The superior vena cava drains blood from most areas superior to the diaphragm and empties into the right atrium. The subclavian vein is located deep in the thoracic cavity. Formed by the axillary vein as it enters the thoracic cavity from the axillary region, it drains the axillary and smaller local veins near the scapular region and leads to the brachiocephalic vein. The brachiocephalic veins are a pair of veins that form from a fusion of the external and internal jugular veins and the subclavian vein. The subclavian, external and internal jugulars, vertebral, and internal thoracic veins flow into it. These veins drain the upper thoracic region and lead to the superior vena cava. The external jugular vein drains blood from the more superficial portions of the head, scalp, and cranial regions and leads to the subclavian vein.7
Figure 3. Major systemic arteries. Image from Steven Telleen, OpenStax (CC BY: Attribution).

Figure 4. Major systemic veins. Image from OpenStax, Anatomy and Physiology (CC BY 4.0).

**Purposes of IV Infusion Therapies**

There are many reasons for introducing an IV infusion into a client. Intravenous infusion therapy is prescribed to persons who require electrolyte replacement, restoration and/or maintenance of fluid balance, to provide nutrition, to administer intermittent, continuous, or emergency medications, to administer chemotherapies, and to transfuse blood and blood products. It is also used to gain venous access for emergencies, to administer diagnostic reagents, and to administer general anesthesia or procedural sedation.⁸

Body fluids are critical to the maintenance of life and to homeostasis. Since this information is important for LPN practice and for maintaining safety in the administration of IV infusions, we will pause here to revisit the constitution of fluids in the human body.

Total body fluid is about 60 percent of the body weight. The body fluid content in infancy is 70 to 80 percent of the total body weight. By the time a person reaches 60 years of age, total body fluid is around 52 percent of body weight.
This fluid is contained in three main compartments of the body.\textsuperscript{9}

- **Intracellular Fluid (ICF):** The compartment that includes all fluid in cells surrounded by the plasma membrane. This fluid in the cells comprises approximately 60% of all the water in the body.\textsuperscript{10}

- **Extracellular Fluid (ECF):** This fluid is made up of two components—blood and plasma. “Approximately 20% of this fluid is found in plasma.”\textsuperscript{11} We commonly associate this fluid with the cerebrospinal fluid that bathes the brain and spinal cord, lymph, the synovial fluid in joints, the pleural fluid in the pleural cavities, the pericardial fluid in the cardiac sac, the peritoneal fluid in the peritoneal cavity, and the aqueous humor of the eye. Because these fluids are outside of cells, these fluids are also considered components of the ECF compartment.\textsuperscript{12}

- **Interstitial Fluid (IF):** This fluid surrounds the cells but is not found in the blood. This is the fluid that transports nutrients and electrolytes between the ICF and the ECF. Surplus fluid in this area is managed by the lymphatic system.\textsuperscript{13}

Fluid moves between these compartments to maintain a balance in the body. Watch this video on body fluids and then review these notes (isotonic, hypotonic and hypertonic IV fluid solution NCLEX review notes). The movement of fluid in the body is facilitated by the processes outlined below.

**Diffusion** is “the process by which molecules and other particles in a solution become widely dispersed and reach a uniform concentration because of energy created by their spontaneous kinetic movements. Electrolytes and other substances move from an area of higher concentration to an area of lower concentration.”\textsuperscript{14}

**Osmosis** is the process by which “water moves through water channels (aquaporins) in a semipermeable membrane along a concentration gradient, moving from an area of higher concentration to one of lower concentration.”\textsuperscript{15}

**Osmotic pressure** is “the pressure that water generates as it moves through the membrane.” Unless a state of equal diffusion is achieved beforehand, this pressure increases until it opposes the flow of water.\textsuperscript{16}

**Active transport** involves mechanisms whereby “cells use energy to move ions against an electrical or chemical gradient.” Primary active transport mechanisms use “the source of energy...directly in the transport of a substance,” whereas secondary active transport mechanisms “harness the energy derived from the primary active transport of one substance, usually sodium, for the cotransport of a second substance.”\textsuperscript{17}

**Filtration** refers to “the direction and magnitude of fluid movement across capillary walls,” and it takes place “when net fluid movement is out of the capillary into the interstitial spaces.”\textsuperscript{18}

**Hydrostatic pressure**, the force exerted by a fluid against a wall, causes movement of fluid between compartments. The hydrostatic pressure of blood is the pressure exerted by blood against the walls of the blood vessels by the pumping action of the heart. In capillaries, hydrostatic pressure (also known as capillary blood pressure) is higher than the opposing colloid osmotic pressure in blood—a constant pressure primarily produced by circulating albumin—at the arteriolar end of the capillary (see Figure 5). This pressure forces
plasma and nutrients out of the capillaries and into surrounding tissues. Fluid and the cellular wastes in the tissues enter the capillaries at the venule end, where the hydrostatic pressure is less than the osmotic pressure in the vessel. Filtration pressure squeezes fluid from the plasma in the blood to the IF surrounding the tissue cells. The surplus fluid in the interstitial space that is not returned directly to the capillaries is drained from tissues by the lymphatic system and then re-enters the vascular system at the subclavian veins. 

Figure 5. Capillary exchange. Image from OpenStax College (CC BY 3.0).

Electrolyte balance is key in facilitating and maintaining the above processes, apart from their other functions. All the electrolytes in the following learning activity are available to be given intravenously to provide, maintain, or correct fluid and electrolyte balances or to treat other associated comorbidities. Their uses must be approached with caution, particularly if they are being administered as a dedicated treatment or therapy.

The administration of electrolytes, fluids and medications through intravenous infusion (e.g., 20 mEq Potassium Chloride in 0.9% Sodium Chloride) must be performed in accordance with legislation, regulation, CLPNA standards and policy documents, and employer policy. The core importance with the administration and management of the IV infusion therapy is that the LPN has the education, knowledge and skills to administer and monitor intended actions, unintended effects and how to respond to intended and unintended effects.

The LPN’s decision to administer anything intravenously to the client must always include the client’s individual health needs identified through health assessment, the LPN’s competence and the availability of supports in the practice environment to ensure safe nursing practice and best client outcome.

Nurses working with infusion therapy can find useful information and resources at the Infusion Nurses Society (INS) in the United States of America and the Canadian Vascular Access Association (CVAA). The websites of these organizations also offer learning opportunities to help nurses stay current with infusion therapy.
Learning Activity

In this learning activity, you are asked to complete the table by adding the missing information. You should first identify in the left-hand column whether the electrolyte is intracellular or extracellular. Then complete the right-hand column with the functions of the electrolyte and the indications of imbalance in either direction—lower or higher levels. In addition, if you can think of any specific issues related to IV infusion of the electrolyte, you should add those in the right-hand column. (Suggested answers on page 10).

<table>
<thead>
<tr>
<th>ELECTROLYTE</th>
<th>FUNCTION/INDICATIONS OF IMBALANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium (K+)</td>
<td></td>
</tr>
<tr>
<td>Magnesium (Mg++)</td>
<td></td>
</tr>
<tr>
<td>Sodium (Na+)</td>
<td></td>
</tr>
<tr>
<td>Chloride (Cl−)</td>
<td></td>
</tr>
<tr>
<td>Bicarbonate (HCO3−)</td>
<td></td>
</tr>
<tr>
<td>Calcium (Ca+)</td>
<td></td>
</tr>
</tbody>
</table>
Summary

Intravenous infusions (peripheral, central) can be used to deliver fluids, medications, nutrition, chemotherapies, and blood and blood products directly into the bloodstream. Epidural and spinal infusions deliver medications and fluids into or surrounding cerebrospinal fluid. This course will discuss each of these infusions in some detail. Infusion therapies are not without their complications and must be managed effectively by the nurse to avoid or minimize these effects for the client. Due to the directness of these routes, the potential for infection is high. Nurses must be fully aware of infection prevention and control methods for each of these therapies and act accordingly. Infection control is discussed in each module of this course in relation to the specifics of the content. Because of the range of equipment and infusions, it is first necessary to review terminology to ensure clarity as we move forward. Module 2 provides a number of key definitions that LPNs practicing in this area must understand.
Answers to learning activity

Potassium (K+)
“The distribution of potassium between the intracellular and extracellular compartments regulates electrical membrane potentials controlling the excitability of nerve and muscle cells as well as the contractility of skeletal, cardiac, and smooth muscle tissue.”^20

When levels of potassium are low (hypokalemia), signs and symptoms include “dizziness, muscle weakness, leg cramps, cardiac arrhythmia, hypotension, thirst, nausea, anorexia, poorly concentrated urine, [and] polyuria.”^21

When levels of potassium are high (hyperkalemia), signs and symptoms include “nausea and vomiting, intestinal cramps, diarrhea, paresthesias, weakness, dizziness, muscle cramps, changes in electrocardiogram, [and] risk of cardiac arrest with severe excess.”^22

Magnesium (Mg++) (Intracellular)
Magnesium “acts as a cofactor in many intracellular enzyme reactions...[and] is essential to all reactions that require ATP, for every step related to replication and transcription of DNA, and for the translation of messenger RNA...[and] is required for cellular energy metabolism.”^23

A low level of magnesium (hypomagnesemia) “usually occurs in conjunction with hypocalcemia and hypokalemia,” and signs and symptoms include “personality change, athetoid or choreiform movements, nystagmus, tetany...tachycardia, hypertension, [and] cardiac arrhythmias.”^24

When levels of magnesium are high (hypermagnesemia), signs and symptoms include “lethargy, hyporeflexia, confusion, coma, hypotension, cardiac arrhythmias, [and] cardiac arrest.”^25

Sodium (Na+) (Extracellular)
Sodium “serves as the primary determinant of blood osmolality.”^26 It is also “important in regulating acid-base balance...[and] contributes to the function of the nervous system and other excitable tissue.”^27

When levels of sodium are low (hyponatremia), signs and symptoms include “muscle cramps, weakness, headache, depression, apprehension, feeling of impending doom, personality changes, lethargy, stupor, coma, anorexia, nausea, vomiting, abdominal cramps, [and] diarrhea.”^28

When levels of sodium are high (hypernatremia), signs and symptoms include “polydipsia, oliguria or anuria, high urine specific gravity, dry skin and mucous membranes, decreased tissue turgor, tongue rough and fissured, decreased salivation and lacrimation, headache, agitation, restlessness, decreased reflexes, seizures and coma, tachycardia, weak and thready pulse, decreased blood pressure, [and] vascular collapse.”^29

Chloride (Cl-) (Extracellular)
“Chloride movement is often associated with sodium and plays a role in regulation of acid-base balance.”^30

When levels of chloride are low (hypochloremia), signs and symptoms include “increased muscle tone, twitching, weakness, tetany, shallow, depressed breathing, respiratory arrest, [and] mental confusion.”^31
When levels of chloride are high (hyperchloremia), signs and symptoms include “hyperchloremic metabolic acidosis, deep, rapid breathing, weakness, headache, diminished cognitive ability, [and] cardiac arrest.”

Bicarbonate (HCO\textsubscript{3}–) (Extracellular)
One of the primary ways in which the body maintains a normal pH range is through “chemical buffers in the ICF and ECF, the most important of which is the HCO\textsubscript{3}– buffer system... A reduction in pH due to a decrease in HCO\textsubscript{3}– is called metabolic acidosis, and an elevation in pH due to increased HCO\textsubscript{3}– levels is called metabolic alkalosis.”

Signs and symptoms of metabolic acidosis include “anorexia, nausea and vomiting, abdominal pain, weakness, lethargy, general malaise, confusion, stupor, coma, depression of vital functions, peripheral vasodilation, decreased heart rate, cardiac arrhythmias, [skin] warm and flushed...[and] bone disease (e.g., chronic acidosis).”

Signs and symptoms of metabolic alkalosis include “confusion, hyperactive reflexes, tetany, convulsions, hypotension, arrhythmias, and respiratory acidosis due to decreased respiratory rate.”

Calcium (Ca+) (Extracellular)
Calcium “provides strength and stability for the skeletal system and serves as an exchangeable source to maintain extracellular calcium levels.”

It “plays an essential role in many metabolic processes, including activity of enzyme systems, generation of action potentials, and muscle contraction.”

When levels of calcium are low (hypocalcemia), signs and symptoms include “paresthesias, especially numbness and tingling, skeletal muscle cramps, abdominal spasms and cramps, hyperactive reflexes, carpopedal spasm, tetany, laryngeal spasm...hypotension, signs of cardiac insufficiency, failure to respond to drugs that act by calcium-mediated mechanisms...osteomalacia, bone pain, deformities, [and] fracture.”

When levels of calcium are high (hypercalcemia), signs and symptoms include “polyuria, polydipsia, flank pain, signs of acute and chronic renal insufficiency, signs of kidney stones, anorexia, nausea, vomiting, constipation, muscle weakness and atrophy, ataxia, loss of muscle tone, osteopenia, osteoporosis, lethargy, personality and behavioural changes, stupor and coma, hypertension, shortening of the QT interval, [and] atrioventricular block on electrocardiogram.”
Module 2: Descriptions and Definitions

Introduction
Infusion therapy includes many different forms and types of equipment. In this section we provide some helpful definitions before discussing the various therapies themselves. These definitions are taken from reliable sources and can serve as a resource for the remainder of the course.

Outcomes
By the end of this module the LPN will be able to
- identify the common forms of infusion therapies;
- state the definition of terms commonly applied to infusion therapy; and
- provide a description of the main forms of equipment used to deliver infusion therapies.

Peripheral Infusion
A peripheral infusion involves the insertion of a cathlon into the peripherally located veins.

Veins of the extremities are designated as peripheral locations and are ordinarily the only sites used by nurses. Because they are relatively safe and easy to enter, arm veins are the most commonly used [see Figure 1]. The metacarpal, cephalic, basilic, and median veins, as well as their branches, are recommended sites because of their size and ease of access. More distal sites should be used first, with more proximal sites used subsequently. Leg veins should rarely, if ever, be used because of the high risk of thromboembolism.\(^\text{40}\)

Cathlon
A cathlon is an IV catheter. The choice of the term \textit{IV cathlon} used in this document is deliberate, as it reflects a generic name. In the past, people have referred to them as Jelco. Jelco was one of the first plastic catheter-style cathlons on the market, and the name stuck. Jelco is a registered trademark and does not reflect all the brands on the market today.

Central Venous Catheters (CVC)
A central venous catheter, also called a central line, is a long, thin, flexible tube used to give medicines, fluids, nutrients, or blood products over a long period of time, usually several weeks or more. A catheter is often inserted in the arm or chest through the skin into a large vein. The catheter is threaded through this vein until it reaches a large vein near the heart. A catheter may be inserted into the neck if it will be used only during a hospital stay.\(^\text{41}\)

Central Venous Access Device (CVAD)
Central vascular access devices are placed in large blood vessels and permit frequent, continuous, or intermittent administration of chemotherapy, biological therapy, and other products. They are indicated in instances of limited vascular access, intensive chemotherapy, continuous infusion of vesicant agents, and projected long-term need for vascular access.\(^\text{42}\)

Implanted Vascular Access Device (IVAD)
An IVAD is a device that is inserted beneath the skin and used to avoid the complications of central venous puncture. In clients who need multiple central venous access, this device may be
used. The device may end in either central or peripheral access.\textsuperscript{43} The IVAD is placed under the skin and has a reservoir. The purpose of the reservoir is to be an injection site for medications. The reservoir is palpable and often available on the chest. This access point may be used to give fluids, medication, blood products, or TPN. This access may further be used as an access point for blood draws.\textsuperscript{44}

Valves

Any type of CVC (tunneled, IVAD, or PICC) can be open-ended (nonvalved) or closed-ended (valved).

Nonvalved, or open-ended

- The catheter is open at the distal tip.
- The catheter requires clamping before entry into or exit out of the system.
- Clamps are usually built into the catheter.
- Requires periodic flushing with normal saline and heparin lock when not in use.\textsuperscript{45}

Valved, or closed ended

- A valve is present near the distal tip of the catheter (e.g., Groshong) or in the hub of the catheter (e.g., PAS-V).
- Clamping is not required, as the valve is closed except during infusion or aspiration.
- Requires periodic flushing with normal saline only when not in use.
- Clamps will not be present on external portion of catheter.\textsuperscript{46}

Midline Catheter

Midline catheters (MLCs) are single- or double-lumen, non-tunneled polymer catheters. These catheters are used for short-term IV therapy, frequent administration of blood products, blood drawing, and intermittent or continuous drug infusions. A physician, interventional radiologist, or specially trained nurse places these catheters. MLC lines are catheters that are placed between the antecubital fossa and the head of the clavicle. These catheters are shorter than PICC lines (15 to
20 cm), with the tip resting in the larger vessels of the upper arm. Following venipuncture, the needle is withdrawn into a tube, and the catheter is advanced using a catheter advancement tab.47

Percutaneous

Non-tunneled central catheters are used for short-term (less than 6 weeks) IV therapy in acute care, long-term care, and home care settings. The physician inserts these catheters. The subclavian vein is the most common vessel used, because the subclavian area provides a stable insertion site to which the catheter can be anchored, allows the client freedom of movement, and provides easy access to the dressing site. The jugular vein should only be used as a last resort and then only for 1 to 2 days. Single-, double-, and triple-lumen central catheters are available for central lines, but single-lumen catheters should be used for TNA whenever practicable.48

Peripherally Inserted Central Catheters (PICC)

Peripherally inserted central catheters... are single- or double-lumen, non-tunneled polymer catheters... These catheters are used for short-term IV therapy, frequent administration of blood products, blood drawing, and intermittent or continuous drug infusions. A physician, interventional radiologist, or specially trained nurse places these catheters. PICC lines are inserted just above or below the antecubital fossa and advanced to a position with the tip ending in the distal one third of the superior vena cava. These lines are up to 60 cm in length with gauges ranging from 24 to 16. They can be in place for extended periods. The technique for placement of a PICC line involves insertion of the catheter through a needle with the use of a guidewire or forceps to advance the line.49

Short Peripherally Inserted Catheters (PIV)

The PIV is the most commonly seen short-term IV catheter in acute-care settings. These catheters are usually placed in the back of the hand and the lower arm by nurses with advanced education and training in the initiation of a PIV. The catheter is placed without the aid of ultrasound and is used for rapid access during a code situation, hydration, and administration of medications. The medications given through this route are usually antibiotics, analgesics, antiemetics, and diuretics. When not infusing IV fluids, the PIV is usually capped and flushed with saline every 12 hours to maintain patency. As of 2011, the Infusion Nurses Society Standards advise that these catheters be removed and replaced according to clinical indications as opposed to a specific timeframe; however, facility policy may differ and takes precedence over the standards.50

Tunneled

Tunneled catheters are single-, double-, or triple-lumen catheters approximately 90 cm in length with internal diameters ranging from 1 to 2 mm. These catheters are inserted with the aid of local or general anaesthesia through a central vein with the tip resting in the right atrium of the heart. The other end of the catheter is tunneled through subcutaneous tissue and exits through a separate incision on the chest or abdominal wall. A Dacron cuff on the catheter serves to stabilize the catheter and may decrease the incidence of infection. Accurate placement must be verified on a chest x-ray film before the catheter can be used. The Groshong catheter is a special type of tunneled central venous catheter device. The unique feature of this catheter is a pressure-sensitive valve near the distal end that opens with infusion, flushing, or aspiration of blood. When
not in use, the valve remains closed, preventing backflow of blood and air entry.⁵¹

**Epidural and Spinal Infusions**

Infusion of opioids or local anesthetic agents into the subarachnoid space (intrathecal space or spinal canal) or epidural space has been used for effective control of pain in postoperative clients and those with chronic pain unrelieved by other methods. A catheter is inserted into the subarachnoid or the epidural space at the thoracic or lumbar level for administration of opioid or anesthetic agents.⁵²

**Client-Controlled Analgesia**

A drug-delivery system called client-controlled analgesia (PCA) is a safe method for pain management that allows clients to self-administer opioid doses (e.g., morphine, hydromorphone, fentanyl) on demand with minimal risk of overdose...PCAs are portable, computerized infusion pumps containing a chamber for a syringe or bag that delivers a small, preset dose of medication. To receive a bolus dose, the client activates a button attached to the PCA pump.⁵³

Watch this short video that demonstrates how to set up the pump and administer the pain control medication.

**Hypodermoclysis**

Hypodermoclysis is the administration of fluids through a butterfly catheter and is commonly used for clients with limited intravenous access, palliative care clients, and clients at risk for or with mild dehydration. A fine-gauge needle (e.g., 24-gauge) is inserted into the client’s subcutaneous tissue.⁵⁴

### The given terms and information will be used throughout this course. They are common in current nursing practice, particularly in acute areas. Remember to check back here if you forget a term, its meaning, or its purpose.
Module 3: Management of Peripheral Infusion Therapy

Introduction

This section of the course reviews the preparation for and monitoring of peripheral intravenous infusions by nurses. As well as discussing the infusion of fluids, some mention is made of the administration of medications by this route, with all the safety issues this entails. Various IV infusion setups are reviewed, as well as the use of client-controlled analgesia pumps. This includes several short video clips demonstrating various procedures involved in peripheral IV infusions. This module also includes mention of the accurate calculation of infusion rates. Lastly, the administration of chemotherapies is discussed, with all the risks that entails.

Outcomes

By the end of this module the LPN will be able to

- state the factors involved in preparing various forms of peripheral IV infusions;
- explain how the LPN monitors IV infusions;
- describe the actions of the LPN in priming, setting up, monitoring, and discontinuing peripheral IV infusions;
- complete accurate calculations for peripheral intravenous infusions;
- identify the various methods of administering medications through peripheral IV infusions; and
- describe the safety concerns with IV medication administration.

Preparing the IV Infusion

The LPN should first check the order before starting to prepare the equipment. The order should include the type of IV solution, the rate of infusion, the most responsible health practitioner’s signature, and the date. After critically appraising the order (i.e., making sure it is the right fluid for the right client), the nurse must prepare the equipment and infusion for initiation. (As stated previously, this course will not cover the initiation of intravenous infusions, but will focus on preparation, administration of fluids and medications, and monitoring of infusions.) The following video provides instruction on how to assemble and prime the IV line. All IV solutions are sterile in the bag. The outer wrap should be checked for any tears or a large amount of moisture between the bag and the outer wrap, as this may indicate a problem with the solution. Read the product name and expiry date through the outer wrap to ensure you have the correct solution. IV solutions that are premixed, such as KCl, heparin, and nitroglycerine, are in bold red writing to assist in making the correct choice. If you are administering a medicated fluid, all checks conducted for any medication apply. Additionally, do not use an IV solution that is out of its outer wrap. These bags may have nurse-added medications that were not labelled with the final product.

Watch this video on assembling and priming the line (or, as our American colleagues call it, spiking the IV bag and priming the tubing):

Once primed, the line is ready to connect to the catheter port. At this point a sterile dressing is applied to the catheter. A label should be placed on or on the outside verge of the dressing, identifying the date, time, site, and type and size of catheter or needle used for the infusion. The dressing will be changed by the nurse according to the policies of the facility. There are many
brands of these dressings. This short video demonstrates how to apply and remove the dressing.

Often, medication is to be administered intravenously through a secondary process. Usually this involves the use of a “minibag” (50 ml or 100 ml) and a secondary administration set. This video demonstrates how to prime both sets of tubing and attach the fluid and medication bags.

Another part of setting up an IV infusion is the use of a pump to monitor and control the infusion of the fluids and medications. This next video demonstrates the use of the Alaris Pump. The particular brand of IV pump can vary from one location to another, but they all have similar functions.

**Monitoring the IV Infusion**

Once a peripheral IV infusion has been initiated, the nurse must monitor its progress, as well as that of the client. To do this the nurse must be familiar with the order, must monitor the flow rate of the infusion, and must carry out observations of the site, patency, and dressing on a regular basis. Best practice recommends that each bag be labelled with the name of the client, the prescriber, the date and time of administration or hanging, and the initials of the person hanging the solution. In some cases the number of the litre is also on the label; for example, the third bag since admission or initiation of the therapy.

All IV solutions should be infused with a large volume infusion device to prevent fluid overload and decrease the risk of complications. Site assessment is completed according to facility policy—usually this is every two hours. If no policy exists, use critical thinking and clinical judgement regarding the frequency of assessment. Follow facility policy or the Infusion Therapy Standards of Practice to guide how long the solution can remain hanging and the frequency of administration set and site changes.

In some organizations there is a clearly defined rate for “to keep the vein open” (TKVO). If your facility does not have a policy, you must ask the prescriber to order a specific rate. The rationale for this is the variability in nursing judgement surrounding this rate. For example, some nurses believe TKVO is 20 mL/hr, while others believe this rate to be 50 mL/hr. Maintain the IV site according to facility policy, and flush with the appropriate solution.

The saline lock is used to keep a site viable for use for intermittent or emergency medication administration. The Clave needleless system has been used by Alberta Health Services. All peripheral IV infusions are to be flushed with normal saline for injection using the positive pressure technique. Heparin injected into the lock requires a specific physician’s order.

When the need for the IV infusion is no longer evident, the LPN can discontinue the IV on the order of the physician. This process involves the potential to cause infection, so the nurse must act with care and caution. This video demonstrates how to discontinue a peripheral IV infusion.
Calculating the Infusion Rate

During each phase of the process previously described (preparing and monitoring), the nurse will be required to calculate the flow rate for the infusion. Additionally, a part of monitoring the infusion is being conscious of how much fluid has been administered and how much is left in the bag. Sometimes this data needs to be entered into “in and out” charts. Accuracy in these calculations is another aspect of providing safe care to clients. The following activity contains some sample calculation questions. Complete these calculations before moving on to the next part of this module. If you find this exercise challenging, please see the Medication Drug Calculations Self-Study Course.

Learning Activity

1. 1000 mL of normal saline is to be infused over 8 hours using an administration set with a drop factor of 15. Calculate the rate of flow in drops per minute.

2. Calculate the rate of flow in drops per minute when the order is for 500 mL (2 units) of packed cells over 4 hours. Note that blood administration set always has a drop factor of 10.

3. The order is for 500 mL of 5 percent dextrose in water followed by 500 mL of 0.9 percent sodium chloride at 125 mL/hr. You will use an administration set with a drop factor of 15. Calculate the rate of flow in drops per minute.

4. 1000 mL of IV fluid has been running at 125 mL/hr for 5.5 hours. How much of this fluid remains in the container?

5. A litre of 5 percent dextrose and 0.9 percent sodium chloride is infusing at 125 mL/hr. How many hours will it take for this IV to be infused?

6. The order is for 1000 mL of lactated Ringer’s over 12 hours. You will use an administration set with a drop factor of 15. Calculate the rate of flow in drops per minute.

Answers

1. 31 gtt/min; 2. 21 gtt/min; 3. 31 gtt/min
4. 313 mL; 5. 8 hours; 6. 21 gtt/min

Administration of Fluids and Medications

“The goal of intravenous fluid administration is to maintain fluid, electrolyte, and energy demands when clients are limited in their intake and to correct or prevent fluid and electrolyte disturbances from excess losses.” Using intravenous access, fluids can be delivered directly to the vascular system on a continuous basis and for as long as required. This being the case, the health team should monitor the client’s fluid and electrolyte balance to watch for changes for as long as the infusion is operational. “Knowledge of the correct ordered solution, the equipment needed, the procedures required to initiate an infusion, how to regulate the infusion rate and maintain the system, how to identify and correct problems, and how to discontinue the infusion is necessary for safe and appropriate therapy.”

Throughout the duration of the infusion, the nurse must use standard precautions when working with the IV infusion site and equipment to prevent the transmission of potential infections to the client. For more information on standard precautions, review CLPNA’s Infection Prevention and Control self-study course and resources.

Intravenous fluids can be divided into two categories: crystalloids and colloids. Crystalloids, which include glucose, sodium chloride, and lactated Ringer’s solutions, are used most often. The solutes in these solutions mix and dissolve in the fluid and can cross semi-permeable
membranes. As was seen previously in the video, they have different toxicities.

Colloids contain substances (such as protein or starch) that do not dissolve completely in water. They are also unable to cross semipermeable membranes. Thus, these substances remain suspended and distributed in the extracellular space.

Colloids have been used to increase the osmotic pressure in the intravascular space to increase vascular volume in critical situations. Colloids are either semi-synthetic, such as dextran, pentastarch, or hetastarch, or human plasma derivatives, such as albumin, plasma proteins, or blood. Recent evidence suggests that crystalloids are as effective as colloids and are less costly. As well as maintaining fluid and electrolyte balance, intravenous infusions are used to administer medications, chemotherapy, or contrast dye for medical investigations. Medications can be administered directly into the vascular system through a few different methods. One method is IV push, which involves administering the medication directly into a client’s vein through an IV injection port or an IV lock device. This is usually administered over a short period of time (e.g., two to five minutes if administering morphine), but it will depend on the medication. The nurse must always know and look up the medication and get specific instruction about the medication from the drug resource with reference to its IV administration. The guidelines for each drug can be found in sources such as the Compendium of Pharmaceuticals and Specialties (CPS), if not on the drug monograph itself.

Did You Know?
Legislation does not specify what medications can be administered by which provider. This allows flexibility for employers to determine what medications are appropriate for certain providers to administer based on client needs, provider competencies, and the resources available in that specific care environment. LPNs must follow employer policy around the medications considered appropriate for them to administer within a given care environment. In certain areas of practice, employers may require LPNs to obtain site-specific education before performing certain activities within their facility.

The second method of administration is through intermittent IV infusion, which means that the nurse is administering the medication diluted in a fluid and the fluid must be compatible with the medication. This method involves administration over a longer period. For example, you may hang a minibag with the medication in it and deliver the medication over 30 minutes, 60 minutes, or whatever the timeframe is that is ordered for the medication. This may be done as it would be for the administration of any other medication (e.g., four times a day, three times a day, etc.) as directed by the order.

The third method of administration involves continuous IV infusion, where the medication is added to the fluid or is already in the fluid (e.g., potassium), and it is administered through the IV administration set, whether that be peripheral or central. If medications are being administered through central lines, the nurse has to have the specific knowledge base for using central lines and their maintenance and has to be able to manage medication administration, with all the relevant safety precautions. All the usual rights and checks that apply to medication administration are applied to the administration of IV medications too; however, there are often
further safety issues that must be addressed. These issues are discussed in the next module under “Complications.”

The advantage of administering medication by the intravenous route is that, first, it is delivered directly into the vascular system so that more of the medication is delivered to the system faster and problems with absorption that arise with other routes of administration are avoided. Medications delivered by the intravenous route bypass first-pass metabolism. The first pass is a result of medications being broken down by the liver and intestinal walls for oral and rectal medications. Second, once the medication is administered, it has a higher bioavailability for distribution to target cells. Third, this method of medication administration is advantageous in that if the client cannot tolerate oral therapy (e.g., due to nausea), if there are problems with absorption of a medication, or if he or she is on an NPO order in preparation for surgery, the client can still receive the medication without it having any adverse effect on him or her. Intravenous administration of some medications is also less painful than having to have repeat injections. It avoids the inconvenience of injections, especially for clients who are averse to them, or if the drug itself would be an irritant to the skin, the tissues, or the muscle.

Another advantage is that large volumes of medication can be administered through the intravenous route. The administration process can also be discontinued immediately if the need arises. This option may not be available for other routes.

There are also some concerns or disadvantages with intravenous medication administration, the first being that there is an almost immediate onset of action. If there are going to be allergies or reactions to the drug, they will happen very quickly, so the nurse must be alert for that. If the nurse administers the wrong dosage, that can be critical and is not something that can be easily rectified. If a medication is administered too quickly, there can be an instant reaction. In some cases, that can result in hypovolemia or even put the client into shock. Other concerns are covered under the discussions on complications with IV medications in Module 4 of this course.

A key component of intravenous administration of medications is client education. The client needs to know about expectations, how to observe themselves, and what and when to report to the nurse.

Another competency for the nurse regarding administration of medications by IV infusion is accurate calculation of flow rates and knowledge of the rates at which medications can be delivered, as well as the concentrations of drugs in IV fluids and when a drug must be diluted. For example, in the case of intravenous administration of a bolus, most drugs must be diluted. If given in their purest form, severe harm could come to the client or to the client’s blood vessels. Also, the nurse needs to be aware of the frequency with which the medication can be administered, as well as how it is going to be eliminated from the body.

A significant safety issue is the labelling of medications for administration by IV infusion. When a medication is prepared and hung on the IV pole or administered, a label has to be applied to, for example, the minibag, the administration set, or the catheter itself, indicating what the medication is, the date it is given, and the time it is given. The nurse must also be sure to identify the concentration of the drug and expiry date and also to initial the label. Further, administering medications intravenously means that the nurse must assess the client more closely and more
frequently to monitor the impact and effects of the medication and to be alert to any complications that might arise so that intervention can begin as soon as possible. Some medications are more potent than others or more dangerous in that if the wrong dosage is given or if it is administered too quickly, for example, the responses and reactions can be serious. These are referred to by both the Canadian Patient Safety Institute and the Institute for Safe Medication Practices as “high alert” medications.72 These require two nurses to independently check the medication and to apply more vigilance around that checking.

Another safety issue around intravenous administration of medications is related to the medication being in the system within about 30 minutes.73 This means blood monitoring can be conducted quickly to assess the levels of, for example, electrolytes or specific drugs, and thereby the therapy can be withdrawn as soon as it has had its desired effect. In addition, this prevents toxic dosages being given to clients. When the phlebotomist or nurse is withdrawing the blood for testing, he or she should do it from the limb opposite the one where the intravenous infusion is located. If a blood sample is taken from the location of the infusion, this could lead to false results, as there is a higher concentration of the drug at that site because that is where it is being administered. To get a more accurate assessment of the medication, it is better to take the blood sample from a limb that is on the opposite side from where the infusion is being administered.

Another precaution that the nurse must take if he or she is hanging medication in a bag is to ensure the medication is mixed sufficiently in the bag and is not pooling all in one place. This would result in the client receiving a high concentration of the drug and then a lower concentration of the drug.

It is necessary for the drug to be more evenly distributed.74

From a safety perspective, full documentation must be completed for all medications that have been administered as soon as possible after administration. There should be no delays in completing that documentation.

Chemotherapy

One form of medication that may be administered by IV infusion, either through a peripheral line or a central line, is chemotherapy.

In chemotherapy, antineoplastic agents are used in an attempt to destroy tumour cells by interfering with cellular functions and reproduction. Chemotherapy is used primarily to treat systemic disease rather than lesions that are localized and amenable to surgery or radiation. Chemotherapy may be combined with surgery or radiation therapy, or both, to reduce tumour size preoperatively, to destroy any remaining tumour cells postoperatively, or to treat some forms of leukemia. The goals of chemotherapy (cure, control, palliation) will define the medications to be used and the aggressiveness of the treatment plan.75

Infusion chemotherapies are provided to clients in hospitals, cancer clinics, and in-home settings. Due to the potential to damage healthy cells and tissues and the risks these agents pose to health care professionals, nurses may require additional education and training to be able to safely administer chemotherapies.

The nurse plays an important role in assessing and managing many of the problems experienced by the client undergoing chemotherapy. Because of the systemic effects on normal as well as
malignant cells, these problems are often widespread, affecting many body systems.\textsuperscript{76}

The complications of the use of antineoplastic agents are discussed more fully in Module 4 of this course. Suffice to say for now that the risks are not benign. The National Institute for Occupational Health and Safety has issued an alert and guidance on avoiding exposure to these substances due to the serious risks they pose.

Health care workers who prepare or administer hazardous drugs or who work in areas where these drugs are used may be exposed to these agents in the air or on work surfaces, contaminated clothing, medical equipment, client excreta, and other surfaces. Studies have associated workplace exposures to hazardous drugs with health effects such as skin rashes and adverse reproductive outcomes (including infertility, spontaneous abortions, and congenital malformations) and possibly leukemia and other cancers. The health risk is influenced by the extent of the exposure and the potency and toxicity of the hazardous drug.\textsuperscript{77}

Summary

This module has addressed considerations for the management of peripheral intravenous infusions. It has presented the main concerns with fluid and electrolyte infusions and medication administration, including chemotherapies. The LPN’s knowledge in this regard forms the basis for safe practice. Despite this knowledge and practice, complications can and do occur. The next module addresses these complications, their prevention and management.

Learning Activity

1. In the adult client, optimal areas in the upper extremities for vein selection are which of the following?
   a. Veins on dorsal and ventral surfaces
   b. Veins in areas of flexion
   c. Veins near valves and nerve paths
   d. Veins on lateral surfaces

2. One strategy to prevent complications such as phlebitis and extravasation with PIV insertion is to do which of the following?
   a. Choose the largest and longest catheter possible for the vein.
   b. Choose the smallest and shortest catheter possible for the vein.
   c. Choose the vein that is the shortest and hard to touch with palpation.
   d. Choose the vein that is the shortest and soft and resilient with palpation.

3. Application of a sterile, transparent dressing is recommended for routine dressing of a PIV catheter. The clinical rationale for this is to facilitate which of the following?
   a. Frequent site assessment and palpation over the site and surrounding area
   b. Easy identification of catheter gauge size and length for the appropriate therapy
   c. Access to catheter hub for injection of medication into the vein
   d. Frequent dressing replacement to ensure securement to prevent phlebitis
Answers

1. a. Veins on dorsal and ventral surfaces
2. b. Choose the smallest and shortest catheter possible for the vein
3. a. Frequent site assessment and palpation over the site and surrounding area
Module 4: Complications of Peripheral Intravenous Therapy

Introduction

This section of the course focuses on the complications of intravenous infusion therapies. These complications can occur both locally and systemically. Each complication has significance for the safe administration and management of intravenous infusions. As previously stated in this course, these therapies pose several dangers to clients who are dependent on the competence of the individual nurse and the health team for their safety.

Outcomes

By the end of this module the LPN will be able to

- state the local complications that can occur with intravenous infusion therapies;
- state the systemic complications that can occur with intravenous infusion therapies; and
- identify strategies and techniques to prevent and reduce complications in infusion therapy.

Infiltration

“Infiltration is the unintentional administration of a non-vesicant solution or medication into surrounding tissue. This can occur when the IV cannula dislodges or perforates the wall of the vein.”  It can also be the result of client movement that causes the catheter to move or pierce the blood vessel. The nurse can identify this when the IV fluid is noted to be “flowing through the intravenous line at a decreased rate or may have stopped flowing. Pain may also be present at the site and usually results from edema. The pain increases proportionately as the infiltration continues.” The client’s skin may also be cool to touch. To remedy this situation, it is necessary to remove and reposition the IV catheter. The site may be covered with a warm compress and the limb elevated. Frequent observation and monitoring of the old and new sites are required. Also, the client should be asked to report any discomfort at the site as soon as it is noticed.

Extravasation

Extravasation is the leaking of vesicant drugs into surrounding tissue. Common vesicant medications include digoxin, dopamine, cloroxcinil, and vancomycin. This is usually associated with administration of medications that have either a high or low pH into a peripheral cathlon; when the cathlon is dislodged from the vein, the medication goes interstitial and enters the surrounding tissue. Extravasation can cause severe local tissue damage, possibly leading to delayed healing, infection, tissue necrosis, disfigurement, loss of function, and even amputation.

The nurse should stop the infusion immediately and determine the approximate amount of fluid that has infused into the tissue. Notify the physician and pharmacist, and administer an antidote according to the procedure established...
in the facility. The affected limb should be elevated to prevent further progress up the arm. Subsequently, the nurse must assess the limb frequently for motor function, sensation, and circulation.  

**Phlebitis / Thrombophlebitis**

“Phlebitis is defined as inflammation of a vein related to a chemical or mechanical irritation, or both. It is characterized by a reddened, warm area around the insertion site or along the path of the vein, pain or tenderness at the site or along the vein, and swelling.” In some locations, nurses in Alberta use the (universal) phlebitis scale to identify the degree of advancement of the condition.

**Phlebitis Scale**

0 = No clinical symptoms  
1 = Erythema at access site with or without pain  
2 = Pain at access site with erythema and/or edema  
3 = Pain at access site with erythema, streak formation, and/or palpable venous cord  
4 = Pain at access site with erythema, streak formation, palpable venous cord > 1 inch in length, and/or purulent drainage. Swelling of the extremity, tenderness, and redness.

“Thrombophlebitis refers to the presence of a clot plus inflammation in the vein. It is evidenced by localized pain, redness, warmth, and swelling around the insertion site or along the path of the vein, immobility of the extremity because of discomfort and swelling, sluggish flow rate, fever, malaise, and leukocytosis.” The infusion should be discontinued and restarted in a new site, using a new administration set. A warm compress should be applied to the site. When a thrombophlebitis is suspected, the catheter must not be flushed to prevent the clot from entering further into the vein or venous system.

**Infection**

Local infection can be identified by the development of erythema, edema, and purulent drainage from the site. This is usually the result of a breach of asepsis during or after catheter insertion (see “Equipment/Line Problems” below). When an infection is first observed, the IV should be removed and a site swab and catheter tip swab taken and sent to the lab. The site should be cleaned and covered with a sterile gauze swab. The nurse should monitor the client for signs and symptoms of systemic infection.

Systemic infections are more widespread and have several possible causes. They pose a more serious risk to the client.

Sepsis is an infection that has spread to tissues and/or the blood. While viral infections such as Hepatitis and Human Immunodeficiency Virus (HIV) can be caused by a blood transfusion, the complications from these infections can take days, weeks, months, even years to develop a delayed transfusion reaction. Bacterial infections can occur in less than 24 hours.

Catheter Related Bloodstream Infection (CR-BSI), which starts at the hub connection, is the spread of bacteria through the bloodstream. There is an increased risk of CR-BSI with TPN, due to the high dextrose concentration of TPN. Symptoms include tachycardia, hypotension, elevated or decreased temperature, increased breathing, decreased urine output, and disorientation. Interventions include strict adherence to aseptic technique with insertion, care, and maintenance (of the infusion); avoid hyperglycemia to prevent infection.
complications; closely monitor vital signs and temperature. IV antibiotic therapy is required. Monitor white blood cell count and client for malaise. Replace IV tubing frequently as per agency policy (usually every 24 hours). To prevent the spread of infection, the nurse must adhere to infection prevention and control policies. In the case of intravenous infusions, this includes hand hygiene, gloves, personal protective equipment (including goggles if working with potential blood splatter), assembling and using equipment immediately prior to use, and safe disposal of all equipment.

The majority of healthcare-associated blood stream infections (BSIs) are associated with the use of a central venous catheter (CVC). Risk factors for BSI include type of catheter used, catheter insertion site, catheter insertion and care practices, products administered through the line, frequency of manipulation, age group, underlying disease, and severity of illness.

The skin is the main source of microorganisms causing CVC-BSI. This may occur during insertion or later, especially if the catheter is manipulated. Microorganisms may also be introduced into the catheter lumen from the external surface of the catheter or administration tubing at junction sites, especially when these are disconnected, or through cracks in the external portion of the catheter or some component of the administration set. The catheter hub is an important source of infection in tunnelled catheters in place for more than 30 days.

Fortunately, nurses and other members of the health team can prevent and reduce these infection sources and processes. It is possible to reduce central line–associated bloodstream infections (CLABSI) with two bundles of key evidence-based steps:

**Central line insertion bundle:**
- Hand hygiene
- Maximal barrier precautions
- Chlorhexidine skin antisepsis
- Optimal catheter type and site selection
- Avoiding the femoral vein in adults; subclavian preferred to minimize infection risk

Optimal catheter type and site selection in children is more complex, with the internal jugular vein or femoral vein most commonly used. Site preference in children needs to be individualized.

**Central line care bundle:**
- Daily review of line necessity, with prompt removal of unnecessary lines
- Aseptic lumen access
- Catheter site and tubing care

**Abnormal Lab Values**

The first complication we will address is the collection of specimens for laboratory testing. Correct specimen collection and handling techniques are critical for accurate test results. LPNs should be aware of several possibilities that can create the potential for errors to occur. Calgary Laboratory Services provides a table that summarizes errors that can occur in blood specimen collection and handling. This information has been used to inform policy and practice in Alberta. Read this publication before moving forward in this section of the course.

It is not considered routine practice to access central venous lines for the collection of blood. These specimens are usually collected from a peripheral vein. The LPN should be aware that some results from blood collected from a central line may be inaccurate, depending on the intravenous infusion or locking solution infused in
the line. Some examples of tests that can produce inaccurate results in these circumstances include drug levels, electrolytes, and coagulation studies. If a sample is to be drawn from the central line, the nurse must pay careful attention to the technique used. If the lab values obtained appear inaccurate, a further blood sample must be drawn from a peripheral vein.  

Hyponatremia

The Institute for Safe Medication Practices has warned that intravenous administration of fluids can result in electrolyte and fluid abnormalities. One of these is hyponatremia, defined as serum sodium less than 135 mmol/L. The risk for hyponatremia is particularly prevalent in clients postoperatively and in children. This condition can lead to “poor outcomes, including higher in-hospital mortality, increased length of stay, and higher likelihood of discharge to a facility relative to discharge home.” While hyponatremia is mostly the result of the composition of the fluid infused (e.g., hypotonic saline, dextrose in water), the nurse should be aware that other fluid sources can also play a role (e.g., oral intake of water or ice chips). In addition, hyponatremia can be caused by medical conditions that impact the regulation of water and sodium (e.g., those affecting renal function). Consequently, clients receiving intravenous infusions require close monitoring of their vital signs, in-and-out fluids monitoring, weight, and serum electrolytes. This monitoring, along with regular client assessment, can uncover early indications of hyponatremia. It was found that the main themes that resulted in hyponatremia often involved either the incorrect IV solution prescribed or the incorrect amount of the solution infused. As such, it is critical to perform medication safety checks as both the prescriber and the nurse responsible for administration.

Air Emboli

An air embolus is defined as “a significant amount of air introduced into the circulatory system causing blockage of the pulmonary capillaries.” When intravenous infusions are implemented, there is a risk that air could be introduced into the venous system. The risk is, of course, higher for central catheters than for peripheral ones. At the time of catheter insertion or changing of administration sets, it is possible to introduce air into the system. However, “an air embolism is reported to occur more frequently during catheter removal than during insertion, and the administration of up to 10 ml of air has been proven to have serious and fatal effects. Small air bubbles are tolerated by most clients.” Accordingly, the nurse must follow all the procedures around intravenous infusion strictly to avoid this complication.

If strict protocols are not followed, a central catheter can be a port for air entry while (blood) administration sets are being changed. The minimum volume of air for an embolus to be potentially fatal for an adult is 100 mL. Symptoms of an air embolus are: cough, dyspnea, chest pain and shock. A diagnosis is made by an x-ray showing intravascular air. Treatment is to immediately place the client on their left side with the bed tilted so that the head is lower than the feet. This will displace the air bubbles from the pulmonary valves. Air emboli can be prevented by inspection of equipment and adherence to strict policy and procedures for blood transfusion. In addition to the symptoms described, the client may feel anxious and may experience sudden shortness of breath, shoulder or neck pain, agitation, a feeling of impending doom, light-headedness, hypotension, wheezing, increased heart rate, altered mental status, and jugular venous distension. Further interventions include
stopping the infusion immediately, checking for air in the system, applying oxygen at 100 percent, and notifying the physician promptly. Turning the client on his or her left side with his or her head down is designed to trap air in the right atrium.96

An air embolism can be prevented by ensuring the drip chamber is one-third to one-half filled and that all IV connections are tight. The nurse can also ensure that clamps are used when the IV system is not in use and can remove air from IV tubing by priming prior to attaching to client (as shown previously in Module 3).

Allergic Reactions

Allergic reactions are the product of immune responses to antigens in the body. These responses can occur in relation to any substance that is introduced into the body. In the case of intravenous infusions, the most common reactions are to medications, blood, and blood products. As with any allergy, the response can be mild or severe. Common symptoms include hives, itching, rash, swelling, angioedema, bronchoconstriction, and hypotension. In some cases the client can have an anaphylactic response. For more information regarding anaphylactic reactions, review CLPNA’s Anaphylaxis Self-Study Module.

Close monitoring of the client is necessary to identify allergic responses at their earliest points. The nurse’s first response in all cases is to stop the transfusion, check client information against the transfusion, and call the physician. The nurse may also administer epinephrine and an antihistamine medication parenterally, as directed, if the client is having an anaphylactic reaction.

Reactions to blood and blood product transfusions are common and may be allergic responses, febrile reactions, haemolytic transfusion reactions, responses to circulatory overload, or bacterial reactions. Each reaction requires a specific response in addition to the preliminary response outlined previously. With allergic, febrile, and haemolytic reactions, the vein must be kept open with normal saline (0.09 percent). Febrile reactions must be treated based on the symptoms they produce. Haemolytic reactions require the nurse to treat any symptoms of shock, obtain a blood sample from the site, and send the transfusion unit, administration tubing, and filter to the lab for testing, as well as the client’s first voided urine sample. Circulatory overload requires that the client be placed in an upright position, with “feet dependent.” Vital signs are to be monitored. When the reaction is bacterial, the nurse should send the blood bag and a specimen of the client’s blood for culture and sensitivity testing. Antibiotics will also need to be administered as soon as possible.97

For further detailed information about transfusion reactions, see the CLPNA publication Adverse Transfusion Reactions: A Reference for Nurses.

Hypervolemia

Hypervolemia can be produced from an excess of IV fluids leading to fluid accumulation in the lungs (pulmonary edema). “Hypervolemia can lead to circulatory overload (severely compromised heart function) if it remains unresolved.”98 The nurse can recognize this condition when the client exhibits dyspnea, cyanosis, increased work of breathing, tachycardia, frothy pink sputum, and distended neck veins. Pulmonary edema may be heard on auscultation. Stop the transfusion, administer oxygen to the client, and start diuretics. The transfusion can be recommenced at a slower rate.99
Equipment / Line Problems

Nurses are the “guardians” of the intravenous line, and their knowledge of potential infection sites and processes allows them to prevent complications from arising. Lines should not be disconnected without due reason, as this creates the possibility of contamination. There are several areas where infection may access the intravenous line: the nurse’s hands, the microflora of the client’s skin, the hub of the IV catheter, contaminated IV fluid entering the catheter, or contaminated equipment at any time during priming and insertion. Local infection can quickly become systemic infection as it spreads through the blood. The nurse must use the aseptic technique for all procedures related to IV infusion. In addition, equipment and lines must be changed on a regular basis as indicated in the policy and procedure manual of the organization. Covenant Health has produced a table (Maintenance of I.V./Hypodermoclysis Equipment) that outlines an example of current best practice for changing/replacing equipment to prevent infection and transmission of disease, such as catheter-related bloodstream infection.100

Summary

This section of the course has considered the complications that can arise with infusion therapies. There are many issues to consider in this respect. Recognition of the type of IV the client has is important and aids in the recognition of complications that may arise from the specific type of device and treatment. Since this form of treatment involves significant risks for clients, the nurse must possess a high degree of competence to be able to provide for client safety. Every instance requires the utmost attention to detail. Since central lines pose greater risks of complications, the next module of the course will discuss these lines further.

Learning Activity

In this learning activity, you are asked to briefly describe the following potential complications of peripheral intravenous therapy. (Answers are on the next page).

Infiltration
Extravasation
Phlebitis
Thrombophlebitis
Local infection
Systemic infection
Hyponatremia
Air emboli
Allergic reaction
Hypervolemia
Answers

- **Infiltration** is the unintentional administration of a nonvesicant solution or medication into surrounding tissue.
- **Extravasation** is the leaking of vesicant drugs into surrounding tissue.
- **Phlebitis** is inflammation of a vein related to a chemical or mechanical irritation or both.
- **Thrombophlebitis** refers to the presence of a clot plus inflammation in the vein.
- **Local infection** is usually the result of a breach of asepsis during or after catheter insertion.
- **Systemic infections** are more widespread and pose a more serious risk to the client.
- **Hyponatremia** is serum sodium less than 135 mmol/L.
- An **air embolus** is a significant amount of air introduced into the circulatory system, causing blockage of the pulmonary capillaries.
- **Allergic reactions** are the product of immune responses in the body to antigens. In the case of intravenous infusions, the most common reactions are to medications, blood, and blood products.
- **Hypervolemia** can be produced from an excess of IV fluids, leading to fluid accumulation in the lungs (pulmonary edema).
Module 5: Central Line Care

Introduction

This section of the course considers the use of central infusion lines. It lists the types of central access devices in common use and the maintenance required for each line, including dressing changes, cap replacement, flushing, and lock requirements. This section also includes complications that can arise with the use of these lines, how the nurse can recognize them, and what remedies are available in each case.

Outcomes

By the end of this module the LPN will be able to

- identify the various types of central lines in common use;
- explain the maintenance required for each type of central line;
- list the complications that can arise with the use of central lines; and
- state the prevention of and remedies for each complication.

Central Lines and Their Management

To review the information in Module 2 of this course, there are four types of central venous access devices, or central lines: non-tunneled central catheters (also referred to as percutaneous catheters), peripherally inserted central catheters (PICC), tunneled catheters, non-valved (open ended), valved (closed ended) and implanted vascular access devices (IVAD). These devices are used to administer fluids, medications, chemotherapies, and blood transfusions, and to deliver nutrition to the client. Blood transfusions and TPN are dealt with in subsequent modules of this course. In this section we will discuss central lines in general and their maintenance and nursing implications, as well as look at some complications in addition to the information provided in Module 3.

Most central lines are initiated by a doctor or radiologist, or, in some locations, a nurse with specialist education. Regarding the maintenance of central lines, the important concerns include the patency of the line and dressing changes at the site of infusion, management of the infusion, flushing closed-ended catheters and open-ended catheters, capping the catheters and clamping, and the principles for managing multiple lumens in central catheters.

Central lines are inserted to the point where the tip of the catheter terminates in the central circulation at the superior vena cava, where it joins with the right atrium. In some cases the line enters the right atrium, although this may be problematic. As well as providing for the administration of various medications and fluids, central lines also allow access to draw blood samples for hemodynamic monitoring during infusions. The type of device used will depend on the condition of the client and the purpose of the administration. The insertion site is covered with a dressing, which only requires changing infrequently. The dressing may be an occlusive gauze dressing that needs to be changed every two to three days, or it may be a transparent semipermeable membrane (TSM) dressing that only requires changing every five to seven days. These dressing should also be changed whenever there is any moisture or dampness, if it comes loose, or if it is soiled—the dressing must be changed immediately in these situations. The Canadian Centre for Disease Control recommends that central venous access device dressings only be changed if they are damp, bloody, loose, or soiled, and this is supported by the Public Health
Agency of Canada, which makes the same recommendations.\textsuperscript{103} A meticulous aseptic technique must be performed to minimize the possibility of contamination during dressing changes. Transparent dressings are preferable because they allow the site to be inspected without interfering with the catheter or exposing the site to potential contamination or exposure to the air. During dressing changes, both the nurse and the client will wear masks to prevent airborne infections being spread into the site of the catheter insertion. As with peripheral infusions, the dressing will be labelled with the date and time of application, with the initials of the individual nurse who carries out the procedure added.\textsuperscript{104} These details are also documented in the client’s record.

The primary source of microorganisms for catheter-related infections are the skin and the catheter hub. The catheter site is covered with an occlusive dressing, as described previously. The TSM is preferable, and gauze would only be used if the client is not able to tolerate the TSM or is allergic to it. The gauze dressing must be changed after 24 hours and every two days thereafter. TSM must be changed within 24 hours and then every seven days thereafter. If the catheter site is inflamed or draining or has a suspected infection, the TSM dressing may be changed to a gauze dressing. If a gauze dressing is in place, it may be covered with a transparent dressing. In either event, the dressing must be changed every 48 hours or as needed. To change the dressing, the nurse must use a sterile dressing tray and an aseptic technique. The skin must be cleaned in the entire area over which the dressing will be applied. Chlorhexidine swab sticks will be used to clean the area, and the nurse must ensure that the entire area is dry before applying the dressing. Ports are also cleaned at this time using an alcohol wipe, from the exit site to the distal end. The condition of the site at the time of dressing change is recorded in the client’s record, along with the details previously mentioned.\textsuperscript{105} The main types of TSMs currently in use are Opsite IV 3000 or Tegaderm HP, which can be used if the client is allergic or sensitive to the Opsite. The existing dressing should be removed beginning at the device hub and pulling the dressing gently perpendicular to the skin toward the insertion site. Alcohol swabs should not be used to remove the dressing, as that can cause the dressing to disintegrate. When applying the dressing, it should not be stretched because it may become too tight and stretch the client’s skin; this can contribute to skin breakdown. When applying the TSM, it should be applied from the centre outwards so that all the edges are applied last, allowing the dressing to be smoothed out. If there are still some wrinkles, it is not a major concern. This is preferable to stretching the dressing too far and causing damage to the skin. If the client is allergic to the dressing or not able to tolerate it for whatever reason, a gauze dressing such as Mepore may be applied, but this will need to be changed every 48 hours.\textsuperscript{106} When the dressing is being changed, the site should be assessed for redness, tenderness, inflammation, or coolness and pallor, as these may be indications of infections from phlebitis, thrombophlebitis, infiltration, or extravasation. Skin coolness and pallor may indicate fluid infiltration into the interstitial tissue.

Injection caps on the central line should be changed at the same time as the dressing if the client is hospitalized, and every four weeks if the client is an outpatient. The dressing should also be changed if it is leaking or broken, if there is blood trapped in it, or if it has been removed for any reason. When the cap is cleaned, it should be done so vigorously, and cleaning should be extended to 1.5 centimetres above and below the injection cap catheter connection. It should be cleaned with 70 percent isopropanol alcohol and
allowed to dry completely. The cap is to be removed from the catheter lumen using sterile gauze. The new sterile injection cap should be applied to the lumen as soon as the alcohol has dried. When the cap is changed, it should be flushed and locked according to the procedure for the particular central line being used. Any solutions that are infusing into the central line are usually changed every 24 hours or as per the medical orders. The IV tubing is changed every 72 hours, except for tubing that is used for intermittent infusions and lipid tubing, which will be changed every 24 hours.\textsuperscript{107}

Central line catheters can include up to three lumens, which are used more often in situations where maximum input is required. For example, clients in ICU may require several different fluids at the same time or larger quantities of fluid. In this case the central venous catheter is inserted into the neck or the femur. The locations of the catheters are referred to as proximal, median, and distal lumens. The caps on the open-ended catheters create negative pressure (e.g., maxi plus). The open-ended lines also have one or more clamps that are used for flushing when the line is not in use. The femoral lines usually have three clamps, one for each of the lumens. When the lumen is not in use, it must be clamped. All central venous lines are flushed with 20 mL of normal saline prior to the use of the line, to assess for function, and after the use, for various reasons, whether for drawing blood or for infusing liquid, to clear the catheter of blood, and to prevent contact between incompatible medications. Central lines are also flushed routinely when they are not in use and in conjunction with the cap and dressing changes for continuous infusions.\textsuperscript{108} Open-ended central venous catheters will be flushed with 20 mL normal saline and then locked with 5 mL of heparin during intermittent use. For closed-ended or valved catheters, each access lumen is flushed and locked with 20 mL normal saline only. After a lumen in a multilumen catheter has been used, it should be flushed, as should any unused lumens in open-ended catheters, to flush out any blood reflux. It is not necessary to flush unused lumens in closed-ended catheters because the valves will prevent blood reflux. The flushing should be conducted with a start-stop motion to create some pressure at the end of a flush, thus preventing reflux back into the catheter. This technique also helps remove residue, medications, and fibrin from the wall of the catheter. This must be done even if IV fluids are running because the IV pump does not generate enough force to clean the line.\textsuperscript{109}

Complications

Complications with central venous lines can arise in various situations. For example, the line may be misplaced and enter an artery rather than a vein; this will cause complications that are considered the domain of the doctor and not the nurse.

Complications that nurses may be faced with include the \textit{positioning of the catheter}. If the catheter moves out of position, it can either migrate proximally or distally in relation to the superior vena cava, in the first case causing irritation to the lining of the atrium and the potential for cardiac arrhythmias and cardiac arrest. In the latter situation, the catheter migrates distally and can cause irritation in the veins, and it can end up in the wrong location such as the jugular vein. Indications of proximal migration would be atrial-ventricular arrhythmias, shortness of breath, palpitations, and possibly cardiac tamponade if the infusion moves into the myocardium.\textsuperscript{110} When the catheter migrates distally, the client will hear swishing and gurgling in the same side ear while the catheter is being flushed, indicating that the tip is in the jugular
vein or that infiltration or extravasation is occurring. Prevention of these situations is through securement of the central venous access device at the time it is being inserted and continuing to ensure that it is secure at all times. The catheter should be measured and the length of it documented in the client’s chart so that all staff are aware of what to expect and how to identify when the catheter has shifted. If migration is suspected, the catheter cannot be used until after radiographic confirmation of its location. If it has advanced proximally, it is possible to use radiography to withdraw it; however, if it is distally migrated, it cannot be advanced or used, so it must be withdrawn and a new line inserted.\textsuperscript{111}

Another complication with central lines is the possibility of occlusion. This would be indicated by the inability to flush or aspirate blood from the line, slowness and sluggishness in the line, or evidence of blood return. The catheter should be flushed promptly after all uses and infusions and positive pressure maintained at all times. It should also be ensured that the flush solutions and drugs that are being inserted into the line are compatible. If occlusion occurs, the nurse should assess the cause. If it is a blood clot, there are nurses who are qualified to instill thrombolytic injections, with a physician’s order. If it is a chemical occlusion, the physician needs to be informed and will consider removing the line and starting again.\textsuperscript{112}

A further complication in central lines can be a brachial plexus injury, which is a nerve injury. Nerve injury can occur with insertion of the line or rubbing after the line has been inserted. Nerve injury requires long-term rehabilitation and recovery.\textsuperscript{113}

More complications can occur with central lines in terms of the possibility of an air embolism. If an air embolism is suspected, a client would be showing signs of respiratory distress, unequal breath signs, and weak pulse. The catheter should be clamped immediately and the client turned on his or her left side until the medical staff can arrive. As one of the complications mentioned, the device itself can become faulty or fractured, and the catheter can be damaged or broken. The nurse needs to observe for damage in the line, especially before insertion; after it has been inserted, it should be monitored for damage on a regular basis. This check should be completed every shift. The nurse should look for leakage of fluid when flushing or during infusion. If the proper clamping procedure is followed, this should not happen. Only the approved clamps for the particular device should be used. Sharp objects should be kept clear of the catheter, and needles should not be used to flush. If the client is experiencing any signs of distress or if the tubing itself is under duress, the infusion should be stopped and clamped close to the client’s chest. The physician should be notified, and a repair kit should be ordered for the physician to use. If the catheter is broken, fluid or blood would leak out, especially through the dressing. The nurse needs to keep sharps away from the catheter and check the position of clamps before flushing, as this can lead to errors and damage. Syringes smaller than 10 mm should not be applied to a central line.\textsuperscript{114}

Infection and sepsis are always risks and should be monitored. The nurse should constantly be assessing for indications of infection, either locally or systemically, and acting to prevent or improve the situation when it occurs. The client should be monitored on an ongoing basis. Vital signs are observed hourly. Cultures can be taken from the insertion site if any drainage is noted. The nurse should use aseptic technique and be rigorous in technical activities around the central venous line and dressings. It may be necessary to remove the
line and send the catheter tip, the line, or the hub for inspection and testing in the lab.

Another possible complication is hemorrhage or hematoma. The nurse must observe the insertion site routinely, as previously described in this course. A small amount of bleeding is expected for the first 24 hours, but bleeding beyond this should be assessed as a potential hemorrhage. Pressure should be applied to the site, but if bleeding continues the physician should be called, and the infusion may need to be discontinued. If a hematoma or bruising starts to develop at the site, the nurse should monitor for spread of the bruising. This may indicate that the vein has been damaged during the insertion, or it may be the result of coagulopathies in the client.\(^{115}\)

For flushing guidelines, nurses should refer to their employers’ policies and procedures manual, as well as the manufacturers’ guidelines.

### Summary

While central lines can pose significant risks to clients, they are used more frequently in health care to facilitate more effective and/or efficient treatment. Nurses involved in the care of clients where these devices are applied may require additional education to become competent in their use and management. Clients depend on the rigor and competence of the nurse for their safety and the overall effectiveness of their treatment. Review CLPNA’s Competency Profile (Section V) to become familiar with basic and additional competencies in this area.

### Learning Activity

1. Name three advantages of using a transparent dressing instead of a gauze pad.

2. When engaging in central line care, what information is important to include in the client’s record?

3. A catheter is deemed “patent” when there is an ability to easily aspirate blood from the catheter lumen, in addition to which of the following?
   a. The ability to easily infuse or flush fluid through the catheter lumen
   b. The inability to easily infuse or flush fluid through the catheter lumen
   c. The ability to document signs and symptoms of thrombosis
   d. The inability to document signs and symptoms of thrombosis

4. When assessing for catheter patency, it is recommended to attempt to flush with which of the following flush solutions?
   a. Alteplase
   b. Normal saline (NS)
   c. Heparin sodium
   d. Ethanol
Answers

1. Name three advantages of using a transparent dressing instead of a gauze pad.
   - It is not routinely changed with dressing or tubing changes.
   - It allows the site to be inspected without interfering with the catheter or exposing the site to potential contamination or air.
   - It adheres well and is more comfortable for the client.

2. When engaging in central line care, what information is important to include in the client’s record?
   - The date and time of insertion.
   - The time of the dressing change.
   - The name of the person who carried out the procedure.
   - The condition of the site.
   - The length of the catheter.

3. a. The ability to easily infuse or flush fluid through the catheter lumen

4. b. Normal saline (NS)
Module 6: Blood and Blood Products

Introduction

This section of the course addresses the transfusion of blood and blood products. “All health care practitioners who administer blood or blood products must complete specific training for safe transfusion practices and be competent in the transfusion administration process. Always refer to the agency policy for guidelines for preparing, initiating, and monitoring blood and blood product transfusions.” The information in this module provides a review of the various aspects of blood and blood product transfusions, blood and blood groups, the monitoring and nursing care of the client, and adverse reactions and their management. It also discusses the preparation and education of the client, as well as ethical and legal issues surrounding transfusions. It concludes with discussion of discontinuing infusions and post administration follow-up.

LPN Profession Regulations

At this time, it is not within the LPN’s scope of practice to initiate blood transfusions. However, LPNs can assist with client care, collecting the blood (depending on the product and the local policy), monitoring the transfusion, monitoring the client during the transfusion, providing client teaching, and completing associated documentation.

Outcomes

By the end of this module the LPN will be able to

- explain the reasons for typing and cross-matching the client’s blood;
- provide a rationale for obtaining client consent for blood/blood product transfusions;
- identify the steps in preparing the client for blood/blood product transfusions;
- name the equipment required for blood/blood product transfusions;
- assess the indicators of adverse reactions to a blood/blood product transfusion;
- monitor the client before, during, and after a blood/blood product transfusion;
- enter relevant documentation in the client’s health record; and
- state the requirements for providing documentation to clients post transfusion.

Circulatory System and Components, Function and Purpose of Blood and Blood Products, and Typing and Cross-Matching

Blood is a vital component of human homeostasis. Blood constitutes about 8 percent of total body weight. It serves three main functions in the body: it provides a transportation system for nutrients, hormones, gases, and other essential elements needed for cell survival, as well as waste materials; it serves a regulatory function for fluid, electrolyte, and acid-base balance; and it provides a protective system that regulates coagulation and fights infection in the body. Blood is made up of two components: plasma and formed elements. The balance of the two is normally 55 percent plasma and 45 percent formed elements. To serve its functions, blood is carried around the
body by the circulatory system (see Module 1). Blood transfusions involve inserting blood and blood products into the circulatory system through various forms of venous access devices, peripheral and central. However, these procedures are not without some risk to the client. The blood and blood products are derived from donors and, as such, must be typed and cross-matched to the recipient when possible. Donations must also be checked to ensure that they are not carrying viruses or infections to the recipient.

Everyone has antibodies in their serum that will attack foreign antigens. Antigens are found on red blood cells. There are two types of antigens: A and B. Blood typing is determined according to the presence or absence of the antigens, thus producing four possibilities for blood groups: A, B, AB, and O. This form of blood typing is referred to as the ABO system. Group A has A antigens, group B has B antigens, group AB has both, and group O has neither. The significance of these antigens for blood transfusions is that they can result in reactions that cause hemolysis of the infused red blood cells (RBC). For example, if a person with type B blood receives a type A blood transfusion, this can lead to agglutination (the clumping of the transfusion due to antibody activation) of the RBCs and result in serious illness or death.

In emergency situations, type O blood can be administered with minimal negative impact, because it does not contain antigen A or antigen B. For similar reasons, those with type AB blood can receive from any other blood group, as the absence of antigen A and antigen B prevents clumping of donor RBCs.

A third antigen involved in blood typing and cross-matching is the rhesus (Rh) antigen D, also found on the RBC. Those who are Rh positive have the antigen, and those who are Rh negative do not. In this case, exposure of an Rh-negative person (transfusion or during birth) to Rh-positive blood will result in the production of antibodies. A second exposure to Rh blood can result in a severe hemolytic reaction. When no Rh-negative blood is available, in situations of transfusion or childbirth, Rh immune globulin (RhIG, WinRho) may be administered to the client to help prevent the formation of anti-D antibodies.

Normal and Abnormal Lab Values Pertaining to Blood Transfusion

As previously mentioned in Module 4, accurate specimen collection and handling techniques are critical for obtaining accurate lab values. Calgary Laboratory Services has created a table that identifies the factors that can affect blood tests and results. Some of these are relevant for nurses who are managing blood transfusions.

Types of Transfusions Related to Composition and Indications for Use

The primary indication for a red blood cell (RBC) transfusion is to improve the oxygen-carrying capacity of the blood. A physician order is required for the transfusion of blood or blood products. RBC transfusions are indicated in clients with anemia who have evidence of impaired oxygen delivery. For example, individuals with acute blood loss, chronic anemia and cardiopulmonary compromise, or disease or medication effects associated with bone marrow suppression may be candidates for RBC transfusion. In clients with acute blood loss, volume replacement is often more critical than the composition of the replacing fluids. Transfusions can restore blood volume, restore oxygen-carrying capacity of blood with red blood cells, and provide platelets and clotting factors. The most common type of blood transfusion is blood that is donated by another person (allogeneic). Autologous transfusion is the
transfusion of one’s own blood,\textsuperscript{123} a process that is often used in elective surgeries.

Forms of transfusion include whole blood, fresh frozen plasma, packed RBCs, and platelets, which are made from whole blood by sedimentation or centrifugation. Fresh frozen plasma is infused in cases of bleeding due to deficiency of clotting factors. Packed RBCs are used in cases of severe anemia or acute blood loss. Platelets are infused for bleeding and when low levels of platelets are detected in the client’s blood. Cryoprecipitates are made from frozen plasma, which is centrifuged after partial thawing. Albumin, also prepared from plasma, is infused in cases of hypovolemia or hypoalbuminemia.\textsuperscript{124} In the former, it is used as a volume expander. Hypovolemia can also be treated with other plasma-volume expanders, such as 0.9 percent sodium chloride injection, lactated Ringer’s solution, or pentastarch.

Other blood products (plasma protein products [PPPs] or manufactured products) are made from plasma pools from many donors. Because these products contain human proteins, they are considered a blood product.\textsuperscript{125} Examples of these products include several clotting factors and immunoglobulin (Ig), which is administered for primary and secondary immune deficiency, idiopathic thrombocytopenia purpura,\textsuperscript{126} autoimmune and inflammatory disorders, or in transplant surgeries.

**Obtaining, Understanding, and Respecting Informed Client Consent**

Informed consent must be obtained for all blood and blood product transfusions. This has been so since the Kerver inquiry, which followed the “tainted blood” scandal in Canada in 1997. *Kerver* stated that consent should not be assumed and is not included under the comprehensive client care plan. Blood and blood products have known benefits and risks, and, in some cases, there may be alternatives that the client can choose. Thus, the most responsible health practitioner must talk to the client and discuss the indications and benefits of the proposed transfusion, the risks involved, including the risk of not having the transfusion, and the alternative treatments available. This information must be provided in a language that the client can understand. Sufficient time must also be provided for the client to ask questions about any of these aspects, and the conversation must be documented on the consent form.\textsuperscript{127} The consent form must also be signed by both parties (client and most responsible practitioner) and recorded in the client’s health record. On rare occasions, such as in emergency situations, it may not be possible to obtain consent prior to the transfusion. In this situation the consent must be obtained at the earliest possible opportunity. While the consent is valid for treatment, a new consent form is required if the client’s condition changes, if the client refuses any component of the treatment, or if the doctor becomes aware of new or additional information about the client’s condition or treatment.\textsuperscript{128} Nurses should check the specific policies of the health care facility where they work regarding consent.

**Ethical and Religious Beliefs**

Alberta Health Services provides guidance on spiritual beliefs to all staff through its Healthcare and Religious Beliefs publication.\textsuperscript{129} This document provides information about the various religious and spiritual perspectives on medical treatments, including blood transfusions. Jehovah’s Witnesses forbid blood transfusion based on their interpretation of Biblical scripture. The use of recombinant human erythropoietin (r-HuEPO) and some plasma fractions (e.g., albumin,
clotting factors and immune globulins) may be acceptable for some people. Each member of the faith is permitted to decide individually what is personally acceptable and the refusal documentation should clearly reflect the decision of the recipient. Additional information is available from the Jehovah’s Witness Hospital Information Services (Canada) 24-hour emergency line at 1-800-265-0327 or online at JW.org. When a client refuses a transfusion, it should be recorded in the client’s health record by the medical practitioner. If the client refuses whole blood or a blood product but is willing to accept one or more blood derivatives, this specific information should be included in the notes in the client’s health record.

**Legal Right to Refuse**

Clients have the right to refuse transfusion or treatments involving the use of blood components and blood products. Such a decision should follow the informed discussion of the risks of refusal and the benefits of transfusion, as mentioned previously. Refusal should be clearly documented in the client’s medical record in accordance with the facility-specific policies.

**Preparation for Blood Administration**

There are a series of steps that the nurse must follow prior to, during, and post-transfusion. The first of these is to ensure that the signed informed consent form has been completed and is available. The order for the blood or blood product infusion must be confirmed: “type and amount of blood component or blood product to be transfused, rate and duration of infusion, special requirements (e.g., use of a blood warmer, irradiation), sequence of infusion if more than one type of component or product is to be transfused, any pre/post transfusion medications and or laboratory testing requirements, the recipient identification and indication for transfusion (may be documented in the medical record), and route of administration.”

Then the nurse should approach the client and provide information about the planned transfusion, including requesting that the client report any side effects experienced during the transfusion (where possible). An assessment of the client for potential risks of a transfusion reaction should be conducted, along with collecting baseline vital signs and checking the patency of the catheter. If any pre-medications are ordered, they should be administered. The nurse should then confirm that the blood component matches the transfusion order, before confirming the expiration date and time. Next, the client-product identification verification process should be completed in the presence of the client and using the client’s ID band and whatever other source of secondary identification is used by the unit (see facility policies). A second nurse should complete the independent double verification of the blood or blood product and the client. If any issues arise from these checks or with the quality of the blood product, the process should be stopped at this point and the blood transfusion service contacted.

If infusing blood, gather the equipment, prime the administration line, and filter with the blood component or a compatible solution; for example, sterile 0.9 percent sodium chloride (NaCl) solution for IV use. The NaCl must be flushed from the line prior to initiating the component.

If infusing a blood product, the nurse must refer to the facility’s procedures or manufacturer’s product monograph to identify an appropriate administration set and compatible IV fluids. IV fluid must be flushed from the line prior to initiating transfusion of the blood component.
**Note:** LPNs are not authorized to provide the restricted activity of administering (initiation of) blood or blood products. CLPNA interprets “administration” of blood and blood products as “initiation” of the infusion and this includes the first bag or any bags/units thereafter. This would encompass spiking of the bag and initiation of blood into the circulatory system. Once the infusion reaches the client, it would be up to employer policy as to whether the RN initiating the infusion should remain with the client, or as often is the case in team nursing, hand off care to the LPN to manage the ongoing monitoring of the client during the infusion. The “initiation” phase of blood transfusion is the only step of the process LPNs are not currently authorized to perform.

Once the infusion has been initiated, the client must be observed closely for the first fifteen minutes, as this is the most common time for reactions to begin. When possible, the infusion should be provided at a slower rate to begin with to minimize the amount of reaction that may occur. The nurse should observe the client for hives, itchiness, fever or chills, dyspnea, pain, or any notable change in mental status. These symptoms should be reported to the most responsible practitioner immediately. These symptoms will require treatment, and it may be necessary to discontinue the infusion. Additional information about adverse reactions and their treatments are available at CLPNA’s website. In addition, Lewis et al. provides a comprehensive table of acute adverse transfusion reactions, including their causes, clinical manifestations, management, and prevention.¹³⁵

When no indication of an initial reaction is evident, the client should be reassessed 15 minutes after the infusion has been started. Vital signs should be recorded in accordance with facility policy throughout the transfusion. Generally, if the transfusion is going smoothly and the readings are within normal limits, vital signs are recorded at 5 minutes, 15 minutes, and then every hour during the transfusion. These times can be adjusted based on the clinical condition of the client.¹³⁶

**Preferred Peripheral IV Catheter Size and Rationale, CVADs**

To ensure that transfusions can be completed within the timeframe and to avoid complications of agglutination or haemolysis, a larger-gauge catheter is preferred. In adults, peripheral catheters may range from 14 to 24 gauge.¹³⁷ Larger-gauge catheters are preferred for rapid transfusions. The size of the client’s vein must also be a consideration when choosing the catheter size. The same IV site should not be used for administration of blood and medications or any other fluids. Additionally, medications should not be added to blood or blood products or inserted through the same tubing.¹³⁸

Various central venous access devices (CVADs) can be used for transfusion of blood and blood products. CVADs with multiple lumens may allow for infusion of blood through one lumen and medications or other fluids through an alternate lumen. However, administering medications around the same time as the blood product can create a situation of confusion as to whether the client is sensitive and reacting to the medication or the blood infusion. If this can be avoided, it should be. In some situations it is necessary to administer different blood and blood products at the same time. Separate IV sites should be used in this scenario.¹³⁹
Monitoring, Regulating, and Discontinuing Blood and Blood Products

Blood transfusions should be discontinued in the event of a reaction. The administration tuning should be disconnected from the cannula or CVAD to prevent further infusion, but the IV access should be maintained with normal saline to allow for urgent treatment. At the end of the transfusion, the line should be flushed with a maximum of 50 mL of normal saline for blood and with a compatible solution for blood products (according to manufacturers’ guidelines) to ensure that all the infusion has been administered. This also prevents the tubing from becoming blocked with blood cells. If there has been no reaction during the transfusion, dispose of the empty bag and tubing following infection prevention and control policies and procedures. If a reaction is suspected, these elements should be kept, and the nurse should consult with the transfusion service about their disposal.

The nurse should continue to monitor the client, as delayed reactions can occur. Any significant changes in the client’s condition up to six hours after the infusion will be considered in reference to the transfusion as their potential cause. Outpatients will require written instructions as to what to observe for and report. According to Canadian standards (section 11.4.16 of CSA-Z902), inpatients must receive written notification of the transfusion. The nurse will record when this step has been completed in the client health record. The nurse must also document the process that occurred throughout the transfusion and the follow-up on its completion.

Summary

This module has focused on the transfusion of blood and blood products. While some practices are outside the LPN’s scope of practice or are beyond employer’s policies, the LPN plays a role in assisting with these procedures and supporting and monitoring clients before, during, and after their administration. Any LPN who is involved in this area of practice would do well to acquire comprehensive knowledge about each blood and blood product and about the local policies and procedures in place where he or she works. Alberta Health Services and Covenant Health have produced many learning modules (e.g. Transfusion of Blood Components and Products) and policy and practice documents to support health care practitioners in providing safe and competent care to clients. We have referenced some of these sources in this section of the course and recommend that you pursue them for further reading and study.
Learning Activity

1. An individual with type AB blood can receive blood from which of the following blood groups?
   a. Type A
   b. Type B
   c. Type AB
   d. All of the above

2. Most transfusion reactions occur within the first
   a. 5 minutes
   b. 10 minutes
   c. 15 minutes
   d. 30 minutes

3. The LPN’s first priority in preparation for blood administration is to
   a. confirm completion and availability of the signed informed consent form
   b. confirm the order for the blood or blood product infusion
   c. provide the client with information about the planned transfusion
   d. confirm that the blood component matches the transfusion order

Answers

1. d. All of the above
2. c. 15 minutes
3. a. confirm completion and availability of the signed informed consent form
Module 7: Spinal and Epidural Infusions

Introduction

This section of the course addresses the use of spinal and epidural infusions. Spinal and epidural infusions are used for two main purposes: anesthesia and analgesia. Most often they are used in conjunction with major surgeries, particularly major procedures of the abdomen, hip, and thoracic cavity. For nurses to be aware of how these infusions have their effect, it is necessary to understand a few related components: the anatomy of the spinal canal, the medications that are used to provide spinal or epidural anesthesia and analgesia, and the potential complications that can occur as a consequenc

Note: LPNs who have gained competence through additional education (e.g. employment setting) may monitor and regulate epidural infusions. LPNs are not authorized to initiate or remove epidural and spinal catheters. Review CLPNA’s Competency Profile (Section V) for basic and additional competencies in this area.

Outcomes

By the end of this module the LPN will be able to

- define the terms spinal infusion and epidural infusion;
- describe the anatomy and physiology of the spine as it relates to spinal and epidural infusions;
- recall the commonly used medications for spinal and epidural infusions;
- state the most common situations in which spinal or epidural infusions are used;
- formulate nursing interventions to provide safe care to clients receiving spinal and epidural infusions;
- discuss the complications that can occur with spinal and epidural infusions; and
- relate the nursing prevention and management of these complications.

Understanding Epidural and Spinal Infusions

The spinal canal contains the spinal cord, the cerebral spinal fluid (CSF), the membranes surrounding the spinal cord, and the epidural space (Figure 8).

Figure 8. Spinal anesthesia. Image courtesy of PhilippN. CC BY-SA 3.0.

In adults, the spinal cord ends around L1 and L2, and only the remaining nerve roots (or cauda equina) extend beyond this and exit the spinal canal at the lumbar, or sacral vertebrae, in their relevant positions. The vertebrae in the spine are separated into four divisions: the cervical spine, which has seven vertebrae, the thoracic spine, which has twelve vertebrae, the lumbar
spine, which has five vertebrae, and the sacrum, which has five vertebrae. Each of these is referred to by a letter representing the division of the spine and a number indicating the individual vertebra. For example, in the lumbar spine, there is L1, L2, L3, L4, and L5 (Figure 9).  

![](image)

**Figure 9.** Epidural anesthesia. Image courtesy of BruceBlaus. CC BY-SA 4.0.

The spinal cord, which rises to the brain, is surrounded by CSF, as is the cauda equina. These contents are covered by the dura, which is a fibrous membrane that is impervious to water. This is the outermost of the three membranes that surround the spinal cord and the brain. Outside the dura, but still within the spinal canal, is the epidural space. This space contains spinal nerves that are exiting the spinal cord into the body, blood vessels, and fatty tissues.  

**Figure 9.** Epidural anesthesia. Image courtesy of BruceBlaus. CC BY-SA 4.0.

Spinal anesthesia is achieved through the injection of anesthetic solutions into the subarachnoid space—into the CSF directly. This needle is usually inserted into the subarachnoid space below the level of L2 (Figure 8).

The solutions that are injected into the CSF will disperse and, depending on their rate of dispersal and the extent to which they travel, will have the effect of producing various levels of anesthesia. Because these local anesthetics are injected directly into the CSF, they produce a nerve block in the sensory, motor, and autonomic nerves. The impact of these three nerve blocks is the production of vasodilation and, potentially, hypotension as a result of the autonomic blockade. Because the sensory nerves are blocked, the client may feel no pain. With motor blockade, a loss of movement is experienced. The duration of the anesthetic effect is dependent on the drug that is chosen and the dosage that is administered. Spinal anesthesia is useful in lower-body surgeries, including the lower abdomen, the groin, the perineum, and the lower limbs.

Analgesia can also be administered spinally, in the postoperative period, to manage pain. Some opioids will have longer actions than others, and this depends on the choice of the anesthetists. Usually they will choose morphine or fentanyl. Because this drug is being administered into the CSF in the subarachnoid space, which is close to the dorsal horn where the opioid receptors are, there is only a need for very small doses of the opioids to gain control of pain. This is one of the reasons that this option is preferred for analgesia.

Epidural anesthesia can be used in both thoracic and lumbar areas. The anesthetist will insert the needle through the thoracic or lumbar vertebral spaces into the epidural space, ensuring not to go through the dura or into the subarachnoid space. In this way, anesthetic solutions can be introduced into the epidural space. The anesthetist has the option of inserting a small catheter, which is passed through the needle and left in place so that the anesthesia and/or analgesic can be continued postoperatively (figure 9). In this case, the anesthetic solutions do not enter the subarachnoid space or the CSF directly, but have their impact through their interaction with the nerve roots, which are entering and
leaving the spinal cord through the epidural space. In addition to binding with these nerve roots, the medication may be taken up by blood vessels or the fatty tissues that are also contained in that space. In epidural anesthesia, a low dose of solution will block sensory pathways, but will not impact motor pathways or will have a minimal effect on the autonomic pathways. In higher doses, the anesthetic will impact both sensory and motor functions. In addition, the low doses of anesthetic can be combined with epidural analgesia, where opioid medications are introduced through the catheter into the epidural space.

Epidural analgesia can be combined with anesthesia during operative procedures, but is generally used postoperatively to manage pain. In this situation, the epidural catheter is threaded through the needle that is first inserted into the epidural space, and the catheter is then advanced eight to ten centimetres upward, toward the client’s head (Figure 9). The needle is then removed, and the catheter is taped to the skin, which allows for continuous or intermittent infusion of analgesics. The epidural catheter needs to be placed as close as possible to the dermatomes (Figure 10) that are the target of the analgesia following the surgical procedure. For example, if the client has a wound in the lower abdomen, the analgesia can be specifically focused at the dermatomes surrounding the area of the wound. Other dermatomes can be free of anesthesia or analgesia, thus maintaining their function. This is another benefit of an epidural infusion.
Medications introduced into the epidural space can also diffuse across the dura matter and into the CSF, where they will attach to the opioid receptors in the dorsal horn of the spinal cord. This being the case, analgesia can be achieved with much lower doses of medications than required in situations where medications are used intravenously or by other methods, such as intramuscular injection.  

Spinal and epidural catheters usually remain in place for 48 to 72 hours and require an order from the anesthetist to be removed. When they are being removed, the nurse will need to follow the facility’s guidelines and policies, especially in the case of clients who are receiving anticoagulants.

Epidural anesthesia is commonly used for vascular procedures involving the lower extremities, for knee or hip replacements, in situations of trauma, or where clients have irretactable pain due to cancer. Epidural anesthesia may also be used during labour and childbirth. These methods of anesthesia and analgesia can allow clients to be fully awake during surgeries, or if there is a

Figure 10. Dermatomes and cutaneous nerves (anterior and posterior). Image courtesy of Mikael Häggström. Used with permission.
Concern, sedation can be added through an intravenous line. In any event, an intravenous line should always be started when epidural or spinal infusions are going to be used. The advantages of using these methods of anesthesia and analgesia are that they can provide better control of pain for clients, the client is minimally sedated, the drugs have longer durations of action when they are administered by this method, and the client can start to ambulate much sooner. It also avoids repeated injections (e.g., intramuscular, subcutaneous), and there are very few hemodynamic effects on the client.

Contraindications for using epidural infusions include client refusal or if there is a known drug allergy that is identified in advance of the procedure. Also, if there are any issues with coagulation that pre-exist the infusion, it may be too risky and a decision would be made not to proceed with this type of infusion. Lastly, when there is a pre-existing infection at or near the insertion site, the infusion would not go ahead. Those who have spinal deformities, abnormalities, or injuries would not necessarily be excluded from epidural or spinal infusions, but it may be more difficult to perform the procedures. In situations of systemic infection, while there may be benefits from this method of infusion, the decision to go ahead may be based on the degree of recovery and would be taken by the anesthetist.

There are several methods by which medication can be administered in spinal and epidural infusions. They can be administered by a clinician-administered bolus, they can be administered through continuous epidural infusion, or they can be administered through client-controlled epidural analgesia. In the latter case, the client uses a hand control that is connected to the infusion pump to deliver a bolus of medication into the epidural catheter. This device can be used alone or in conjunction with a continuous epidural infusion to supplement the basal rate. The advantage of this is that the client will have a continuous basal infusion rate that keeps him or her comfortable, but when the client has breakthrough pain, he or she can administer a bolus immediately, which allows for more timely pain relief. It also gives the client more control, which is reassuring to him or her and reduces anxiety, which, in turn, reduces the perception of the severity of pain. It is also convenient for the nurse and client because it reduces the time required in obtaining and administering supplemental boluses.

There are two main medications used in these infusions: opioids and local anesthetics. These can be used alone or in combination to manage pain. They are often used together to treat acute pain because they can work synergistically. They also allow for better pain control at much lower doses of opioids than would normally be given or if opioids were used alone. There are very few central nervous system side effects from these low-dose administrations. It has also been noted that there is less nausea and fatigue and the client is more alert and mobile. These methods also appear to reduce cardiovascular, pulmonary, and infectious complications.

When opioids are administered to clients, they work by attaching to particular receptors in the posterior dorsal horn area of the spinal cord. It is believed that they inhibit the release of a neurotransmitter called substance-P. As a result, the transmission of painful impulses upward to the brain is reduced or modified. Epidural opioids act primarily at the level of the spinal cord and less at the level of the brain stem. In that way, epidural opioids produce analgesic effects without having any, or very minimal, impact on the brain, such as sedation or respiratory depression. Over a long period of time—up to as many as 12 hours after the
injection—the drug (e.g., morphine) spreads in the CSF and slowly moves upward. As it is moving up, it is slowly being taken up throughout the spinal cord by the nerves and blood vessels and is being diluted as it mixes with the CSF. Because of that, the amount remaining that reaches the brain has very minimal effect. It is possible that a morphine concentration could get high enough to cause sedation or respiratory depression, but that is a rare occurrence. However, the nurse needs to monitor the client closely because this delayed response could occur.  

The commonly used opioids for spinal anesthesia or epidural analgesics are epidural morphine, hydromorphone, fentanyl, and meperidine. The key factor in the onset and duration of action of the drug is its solubility properties. Lipophilic opioids are more fat soluble and are absorbed quicker and have a shorter duration of action than hydrophilic opioids, which are more water soluble. The latter have a slower onset but a longer duration of action. This also affects the administration of the drug and the duration of required client monitoring. Epidural local anesthetics are drugs such as bupivacaine or ropivacaine; these drugs are used postoperatively for pain management. The drugs work by blocking the painful sensation at the nerve root before it reaches the spinal cord; thus, it produces relief along the impacted dermatomes or implicated dermatomes. There may be some numbness that occurs in and around the incision or targeted area, but that is anticipated and intended.

**Infusion Pump**

The infusion pump is usually set up and started by the anesthetist. After that, it is managed by nurses who have completed additional competency education in epidural infusions. To increase client safety and avoid errors, epidural

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> Figure 11. Epidural catheter pump (with opiate locked inside tamper-proof box). Image courtesy of Daniel Schwen. CC BY-SA 3.0.

> Equipment is usually yellow, and a label is attached indicating “epidural.”

The nurse’s role is to ensure the pump is running correctly and delivering the amount of drug ordered in the timeframe identified. The nurse must also manage the care of the client receiving the infusion, conducting all assessments and observations identified below.

It is recommended that medications for infusion are prepared by the pharmacy, usually in a minibag, as can be seen above.

“Some common epidural solutions for continuous infusion are:

- Bupivacaine 0.1% with Fentanyl 2 mcg/mL in NS
- Bupivacaine 0.08% with HYDROMorphone 20 mcg/mL in NS
- Bupivacaine 0.0625% with Fentanyl 2 mcg/mL in NS
- Ropivacaine 2 mg/mL (0.2%) in NS (local anesthetic only)

When the epidural infusion is stopped, the local anesthetic effects last for approximately:
- Bupivacaine 0.1% (1 mg/mL) 3.5–5 hours
- Ropivacaine 0.2% (2 mg/mL) 4–6.5 hours

A common local anesthetic used for spinal anesthesia is:
- Bupivacaine 0.5%—duration is 1.5–2 hours (approximately)\textsuperscript{170}

“A filter may be added to the proximal end of the infusion catheter to ensure no small particles (e.g., glass) are introduced into the epidural space. All medications should be drawn up using a filtered needle in case no filter is used on the line."\textsuperscript{171} When the infusion is being administered over a prolonged period, the tubing should be changed every 72 hours. The tubing should be yellow-lined, non-ported tubing with the Luer connection secured to the catheter and tape intact. A label should be attached to the tubing, indicating the last date and time it was changed. A transparent dressing should be used to cover the insertion site, and the site should be checked at least twice per shift. If leakage is noticed or the catheter becomes disconnected or there are any concerns about the infusion, the anesthetist should be notified; it may also be necessary to stop the infusion.\textsuperscript{172} All epidural medications and infusion equipment should be kept separate from intravenous medications and equipment to avoid errors of administration.

\section*{Anesthetist Responsibilities}

When an epidural infusion is first set up, it should be done by the anesthetist; the first dose of the opioid should also be administered by the anesthetist. This is to ensure correct placement of the catheter and to avoid complications that could result from misplacement. The anesthetist will also write an order for the opioid, indicating the route, dose, and frequency before the client leaves the recovery room. The anesthetist also must write orders for epidural infusions—either with or without client-controlled epidural analgesia (PCEA)—opioids alone, local anesthetic alone, or a combination of both. The anesthetist must also identify titration rates and any adjunct therapies, as needed.\textsuperscript{173}

The anesthetist should always be available for consultation (usually the anesthetist who is on call) if any questions or problems develop. The anesthetist needs to check in with the nurse and the client daily, as he or she is responsible for monitoring the client’s progress.\textsuperscript{174} The anesthetist is also responsible for any additional orders for systemic opioids, which are not usually prescribed in conjunction with epidural opioids. He or she is required to write an order to discontinue the catheter and to note any specific instructions regarding anticoagulants. Once the catheter is removed, the responsibility for analgesia is passed back to the attending physician.

Each facility provides policies and procedures for the use of epidural and spinal infusions. Independent double-checks are required for any solutions or dosage changes that are being prepared to be given by nurses.\textsuperscript{175} LPNs do not usually administer medications in this form, but they do monitor the infusion and the client. They are also responsible for understanding how the
pump works and providing an independent co-check for the nurse who is responsible for the infusion. Nurses are also responsible for teaching clients and their significant others about the use of spinal or epidural analgesia and anesthesia for pain management.\textsuperscript{176}

**LPN Responsibilities and Client Monitoring**

Covenant Health (Certification Module for Epidural/Spinal Analgesia/Anaesthesia, 2017) states the responsibilities of the LPN as “maintaining a continuous epidural infusion, assess, monitor and document the health status of the client who has a continuous epidural infusion. When an LPN receives a client with an epidural into her/his care; the LPN must ensure that the correct medication is infusing at the correct rate, that all of the equipment is in order and that the site is intact. The LPN is responsible to report any untoward effects of the continuous epidural infusion to the nurse in charge, and provide client-family teaching for the use of intraspinal analgesia and analgesia for pain management.”\textsuperscript{177}

Nurses are also responsible for monitoring the progress of clients and for observing for the side effects of the medications.\textsuperscript{178} As with any medication, each has its own specific effects and side effects profile, and the nurse needs to be aware of these and monitor the client for evidence of them—both for the anesthetics and for the analgesics or opioids. The nurse is additionally responsible for monitoring the client’s pain and conducting pain assessments on an ongoing basis to determine the effectiveness of the therapies.

Clients receiving epidural infusions of anesthetics and opioids require frequent observation and assessment. Vital signs should be monitored as directed, especially respirations and blood pressure. Skin integrity should be checked to avoid pressure or injury due to loss of sensation. Clients may experience a relief of pain and misjudge their capabilities, leading to overexertion. Fluid input and output should be monitored closely. Urinary retention is a possibility with epidural infusions, and there may be a need to insert an in-and-out catheter. If this reoccurs, an indwelling Foley catheter may be required.\textsuperscript{179}

It is not uncommon for clients to experience nausea and vomiting during these infusions, although often it is difficult to differentiate whether this is a post-anesthetic response. There may be a need for the nurse to administer antiemetic medications. This requires closer observation of the client to identify the possibility of increased sedation.\textsuperscript{180}

Epidural anesthesia can cause some loss of motor function. The nurse must assess the client’s motor strength and function throughout the period of the infusion. In particular, the nurse must assess prior to ambulation and encourage the client not to ambulate alone the first few times. In addition, the client may need assistance turning in bed.\textsuperscript{181}

Infection is a rare occurrence in epidural infusions.\textsuperscript{182} Nevertheless, the nurse must observe the client for signs of infection and use infection prevention and control processes when delivering care. Temperature should be monitored every four hours. The risks, in this case, are at the catheter insertion site and through the catheter itself. The dressing over the injection is not changed, but can be reinforced if needed. The site should be observed for any redness, swelling, tenderness, or discharge. Strict sterile technique is used for any activity close to the site of the catheter. If necessary, the injection cap can be replaced with a sterile cap by a nurse
who meets the competencies for epidural infusion management, and where it is within that nurse’s scope of practice. This will include facility policies in place to support such practice.

Assessment and Management of Complications

The key observations to assess and anticipate complications are the client’s respiratory rate, blood pressure, level of consciousness, and neurological sensation across the target areas that are impacted by the infusion, as well as other areas that may have latent effects of the administration of the drugs. When medication is administered in a bolus, the observations need to be increased to every 5 minutes for the first 15 minutes and then at 15 minutes and 30 minutes. After that, observations can be conducted hourly if there are no noted untoward effects.183

The use of CNS depressants or other opioids in conjunction with infusions can lead to respiratory depression, although this is an infrequent occurrence, and these medications should only be prescribed by the anesthetist.184 This prevents any confusion or mistakes happening where the client becomes over sedated because of being prescribed drugs with similar effects on the central nervous system by two different health practitioners.

Although respirations remain at a steady rate, they may become shallow, resulting in a lesser-than-adequate tidal volume. Thus, the nurse must not only count the respiration rate, but must also observe the depth of respirations and the client’s oxygenation. End tidal CO₂ monitoring with wave form may assist in assessing ventilatory effort and efficacy.

When the anesthetic wears off, the client should be alert. Epidural analgesia should not produce drowsiness. The nurse must assess the client’s level of consciousness and ensure that the client is rousable when sleeping. Sedation and respiration should be assessed every hour when the infusion is started, extending to every two hours and then every four hours up to 12 hours after the last dose was given.

Here is a sample of a sedation assessment tool.

Richmond Agitation-Sedation Scale

<table>
<thead>
<tr>
<th>Score</th>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+4</td>
<td>Combative</td>
<td>Overtly combative or violent; dangerous to staff</td>
</tr>
<tr>
<td>+3</td>
<td>Very agitated</td>
<td>Pulls or removes tubes or catheters; aggressive behavior towards staff</td>
</tr>
<tr>
<td>+2</td>
<td>Agitated</td>
<td>Frequent no purposeful movement or client-ventilator dyssynchrony</td>
</tr>
<tr>
<td>+1</td>
<td>Restless</td>
<td>Anxious or apprehensive but movements not aggressive or vigorous</td>
</tr>
<tr>
<td>0</td>
<td>Alert &amp; calm</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td>Drowsy</td>
<td>Not fully alert; but has sustained (&gt; 10 secs) awakening, with eye contact to voice</td>
</tr>
<tr>
<td>-2</td>
<td>Light sedation</td>
<td>Briefly (&lt; 10 secs) awakens with eye contact to voice</td>
</tr>
<tr>
<td>-3</td>
<td>Moderate sedation</td>
<td>Any movement (but no eye contact) to voice</td>
</tr>
<tr>
<td>-4</td>
<td>Deep sedation</td>
<td>No response to voice, but any movement to physical stimulation</td>
</tr>
<tr>
<td>-5</td>
<td>Unarousable</td>
<td>No response to voice or physical stimulation</td>
</tr>
</tbody>
</table>


IV access, as previously mentioned, needs to be maintained throughout epidural infusions, and naloxone, oxygen, an airway, and suction should be kept at the bedside at all times during the
infusion and following the last dose for up to 24 hours.\textsuperscript{185} This will allow quick intervention if the client becomes over sedated.

When the epidural catheter is being inserted or from movement of the catheter after insertion, there is a small risk that the dura can be punctured. This will result in leakage of CSF. The client can experience a headache as a consequence, called a post-dural puncture headache.\textsuperscript{186} The headache is frontal and becomes worse if the client moves or tries to sit or stand. The headache can occur between 24 and 48 hours after the puncture. Treatment includes bed rest in a supine position, analgesics, and liberal fluids (IV). If the headache and the leak are not resolved in 72 hours, the anesthetist may perform a blood patch, using the client’s own blood and injecting it into the epidural space to stop the leak. This usually resolves the headache, and the clot (patch) will resolve on its own.

A more serious, if rare, complication is epidural hematoma.\textsuperscript{187} This is the result of damage or perforation to small blood vessels in the epidural space, resulting in bleeding into the epidural space. This can result in compression of the spinal cord, which is an emergency situation. The nurse can recognize an epidural hematoma by observing the client for progressive weakness and sensory changes (paresthesia) well past the expected duration of the block, severe back tenderness, and possible changes in bladder and/or bowel continence. The anesthetist must be contacted immediately if this occurs. Treatment should be immediate and involves surgical evacuation of the hematoma. “Compression of the spinal cord can cause permanent damage within 6–8 hours.”\textsuperscript{188} The risk for epidural hematoma is higher in clients with issues of coagulation or who are on medications affecting coagulation. The risk for hematoma is greater at the time of insertion or removal of the epidural catheter. Clients must be monitored by observing “hip/dorsi/plantar flexion and extension, for changes in sensation to abdomen and legs, and for back pain q4h for 24 hours post epidural catheter removal.”\textsuperscript{189} A further possible complication of epidural infusion is hypotension. It is not always clear that the epidural infusion is the cause, so the nurse must be alert for other possible causes. However, postoperatively, the client may be hypovolemic. One effect of epidural analgesia is a reduction in the levels of circulating catecholamines, such as epinephrine and norepinephrine. These two things together can produce hypotension. A second scenario that can lead to or exacerbate hypotension is the effect of epidural anesthetic agents. These can produce sympathetic nerve blocks in addition to the already blocked sensory nerve blocks. This will result in blood pooling in the extremities, causing postural hypotension.\textsuperscript{190}

To prevent or improve this situation, the client will need replacement fluids. These may be administered through IV and orally. The nurse must also monitor the client’s blood pressure in lying, sitting, and (if relevant) standing positions. The client will be taught to rise slowly, moving from one position to another with some delay between each. On the first few occasions that the client ambulates, he or she should not do so unaccompanied. If the client is remaining in bed, the legs can be elevated, but the nurse must not position the client so as to spread the block (the Trendelenburg position must not be used). The anesthetist will judge whether to use medication. For example, if the hypotension seems to be a result of a sympathetic block, he or she may prescribe ephedrine for the client to reduce the effects of the block.\textsuperscript{191}

A complication, which can be fatal, can occur because of local anesthetic being injected into a blood vessel. This can happen when the infusion catheter migrates into a vein in the epidural
space. If plasma concentrations become high enough, local anesthetic toxicity will develop.\textsuperscript{192} The nurse should observe the client for peri-oral numbness and tingling, a metallic taste in the mouth, dizziness, tinnitus, and anxiety. The epidural infusion must be stopped immediately and the anesthetist contacted. If it is not stopped, “the symptoms can progress to muscle twitching, blurred vision, shaking, excitement, convulsions, bradycardia, heart block, hypotension, confusion, sedation, loss of consciousness and ultimately cardiac arrest.”\textsuperscript{193} The nurse should also administer high-flow oxygen to the client to mitigate some of these effects.

One reason why this is such an infrequent occurrence is that the catheter is always aspirated before administration of any epidural drug. If a lot of blood is witnessed in the aspirate, it will be clear that the catheter is in a blood vessel. The aspirate would usually include a small amount (less than 0.5 cc) of clear fluid, but if clear fluid flows freely into the syringe, that would be an indication of CSF and the migration of the catheter into the subarachnoid space.\textsuperscript{194} This would constitute a dangerous situation, since intrathecal drug doses are one-tenth of the epidural doses. The nurse would note that the client is “unusually drowsy, difficult to rouse, or has a sudden increase in motor weakness or sensory block.”\textsuperscript{195}

The LPN should not reconnect a catheter if it becomes accidentally disconnected. “It is recommended that an epidural catheter be removed as soon as possible following an un-witnessed accidental disconnection.”\textsuperscript{196} This is because the proximal end of the catheter is considered contaminated when this happens. If the hub of the catheter is still in place, it should be capped with a non-vented cap. If apart at the catheter connector, the epidural catheter should be wrapped in sterile gauze. The anesthetist should be called immediately. In these circumstances, the catheter will be removed as soon as it is safe to do so. This may depend on when the last dose of anticoagulant was administered.\textsuperscript{197} If the disconnection is witnessed, a health provider who has met the requirements of the epidural infusion competencies, scope of practice, and employer policies may proceed with reconnection. This procedure involves cleaning the catheter, cutting the catheter (shorter), attaching a sterile connector, and taping the new connection. However, in all situations of disconnection, the anesthetist should be informed and make decisions about reconnection.

A final complication that can occur with epidural infusions is catheter occlusion or dislodgment. The epidural line is different from an IV line in that if the epidural catheter is capped, it does not require flushing. As seen previously (Figure 11), a locked, designated infusion pump must be used for all continuous epidural infusions. If the nurse suspects there is an occlusion or the pump alarms as such, the nurse should inspect the system for integrity and kinks. Occlusion of the catheter can be caused by kinking of the catheter above or beneath the skin, over-tightening of the epidural catheter connector or tubing in the pump being pinched off.\textsuperscript{198} Repositioning the client might also resolve an occlusion alarm. If after checking these items the nurse suspects that the catheter is occluded, the anesthetist must be informed. Meanwhile, the nurse should continue to observe and monitor the client. Observe for changes in the client’s hip/dorsi/planter flexion and extension, for changes to sensation in the abdomen and legs, and for back pain. This monitoring should continue every four hours for 24 hours after the incident, and any unexpected findings should be reported and documented by the nurse.\textsuperscript{199}
Neurological Assessment and Client Monitoring

By identifying the surface area that is anesthetized using ice or an alcohol swab, the sensory level of the block can be determined. “Pain is the easiest modality to block, so movement and sensation of touch are not adequate signs of return of normal nerve function. Cold sensation is the last to return, so checking sensation with ice gives the most accurate assessment of block level.” If there is some motor blockade, the anesthetist may decrease the local anesthetic concentration, change the solution, or decrease the rate of the infusion.

Pruritus (itchiness) is an effect that can occur during infusions, usually a result of irritation from the medications. It may not need treatment unless itching is bothersome to the client.

Gastric motility can also be slowed, depending on the degree of the block. It is usually a sufficient resolution of this problem to have the client on the routine bowel protocol.

Managing Client Care Following Epidural or Spinal Regional Anesthesia / Pain Block

After the epidural catheter is removed, the nurse should continue to monitor and document hip/dorsi/planter flexion, changes in sensation to the abdomen and legs, and back pain every four hours for 24 hours. Abnormal findings should be reported to the anesthetist immediately. The goal is to ensure that motor, sensory, and autonomic function has returned to baseline levels.

The client should remain under observation until two hours have passed since the client last received an epidural solution containing fentanyl or until 24 hours have passed if the client has received an epidural solution containing morphine or hydromorphone. (This does not refer to when the epidural catheter was removed, only to when the medications were last administered). Clients will also receive education regarding the possible signs and symptoms of a latent epidural complication and when, where, and how to access help.

Summary

Spinal and epidural infusions are effective methods of providing anesthesia and pain control. They are applied to several common situations (e.g., surgeries, labour in childbirth, chronic pain, and cancer) in various contexts of practice. These therapeutic treatments are not without risk, and the nurse working with clients receiving these forms of care must be fully knowledgeable with the complications that can arise. LPNs must be familiar the roles they are assigned in the care of clients receiving spinal and epidural infusions. LPNs are important members of the health team providing this form of care to clients and need to demonstrate continuing competence in its regard.
Learning Activity

1. LPNs are permitted to do all of the following except
   a. monitor the client’s oxygenation
   b. provide client and family teaching
   c. remove an epidural
   d. assess neurological sensation

2. After an epidural catheter is removed, how many times will the nurse monitor for back pain in the first 24 hours?
   a. Two times
   b. Four times
   c. Five times
   d. Six times

3. How can a nurse recognize an epidural hematoma?

Answers

1. c. remove an epidural
2. d. Six times
3. The nurse can recognize an epidural hematoma by observing the client for progressive weakness and sensory changes (paresthesia) well past the expected location of the block, severe back tenderness, and possible changes in bladder and/or bowel continence.
Module 8: Total Parenteral Nutrition

Introduction

Total parenteral nutrition (TPN) involves the interdisciplinary team (physician, registered dietitian, RN, LPN, phlebotomists, pharmacy and others). Knowledge of the client’s disease process and nutritional requirements guides each decision when it comes to initiating and maintaining TPN. TPN, or parenteral feeding, introduces nutrients into the bloodstream via intravenous administration. There are various reasons for doing this, either as a supplement to oral feeding and/or tube feeding. In severe cases, TPN is used as the only source of nutrition.

Outcomes

By the end of this module the LPN will be able to

- describe total parenteral nutrition;
- list interventions to be completed before commencing TPN;
- identify the indications for TPN;
- state the composition of TPN solutions;
- explain how to monitor TPN infusions; and
- list common side effects and complications of TPN use.

Did You Know?

You are required to familiarize yourself with the College of Licensed Practical Nurses of Alberta’s literature regarding scope of practice and competency profile related to infusions. Ensure safety of the client, and know your limitations before proceeding with TPN. LPNs are not authorized to provide the restricted activity of administering (initiation) of total parenteral nutrition.

Understanding Total Parenteral Nutrition

The ultimate goal of TPN is to meet the client’s unique nutritional needs, and thus it is different for everyone. Due to its high concentration, TPN must be delivered directly into the bloodstream (bypassing the gastrointestinal system), so it is typically given through a central vein.\(^{202}\) TPN can be maintained via a peripherally inserted central catheter (PICC) or central vascular access device (CVAD). The exact components within a TPN solution are determined based on various factors, which will be explained in further detail later in this section.

It is useful for the LPN to be familiar with infusion therapy related to central lines (PICC and CVAD) to help visualize TPN’s placement in the body (refer to Module 5). Because the tip of the intravenous device lies within the superior vena cava, absolute aseptic technique is required to prevent complications.

The administration of TPN solutions via a central line allows for delivery of vital nutrients over an extended period of time (weeks to years).\(^{203}\) Some of the other benefits of centrally delivered TPN include the following:

- Provides complete nutrition
- Increases ability to trigger tissue regrowth (i.e., wound healing)
- Replaces essential vitamins, electrolytes, and minerals
- Provides large caloric and nutrient sources
Indications for Selection of TPN
- Absorption impairment
- Inability to tolerate enteral feeding
- Gastrointestinal tract blockage
- Nutritional impairments

Composition
Because clients using TPN cannot meet their nutritional needs by enteral route, formula selection needs to be client specific. A combination of carbohydrates, proteins, lipids, electrolytes, and vitamins can be provided. Unlike other intravenous solutions, all components of a TPN are compounded using aseptic techniques in the pharmacy. A standard TPN solution can contain the following components:
- Amino acids
- Dextrose
- Protein
- Minerals
- Fats
- Vitamins
- Trace elements

TPN solutions are prepared by a pharmacy, usually in sufficient amounts for a 24-hour continuous infusion. The orders are reviewed each day and may be modified to address the client’s emerging needs and any changes identified in the client’s bloodwork. The orders may also change to align with the client’s health status.205

TPN is made up of two components: amino acid/dextrose solution and a lipid emulsion solution. It is ordered by an authorized health professional, in consultation with a dietitian, depending on the client’s metabolic needs, clinical history, and blood work. The amino acid/dextrose solution is usually in a large volume bag (1,000 to 2,000 mL), and can be standard or custom-made. Lipid emulsions are prepared in 100 to 250 mL bags or glass bottles and contain the essential fatty acids that are milky in appearance. At times, the lipid emulsion may be added to the amino acid/dextrose solution. It is then called 3 in 1 or total nutrition admixture.206
Total nutrient admixtures (TNAs) are solutions that have dextrose, amino acids, and fat emulsions mixed into one large solution container. These are commonly known as “all-in-one solutions” or “three-in-one solutions.” Their appearance is milky white and opaque. TNAs are time-saving as they come premixed, and this reduces the risk of contamination because the nurse need not add anything to them. It is important to note that this TPN solution must be delivered via a special filter set. (Please refer to your institution’s policies and procedures relating to TPN equipment.)

The two-in-one solutions contain amino acids and dextrose only; lipids are infused separately. The flexibility in the amount of amino acids and dextrose is an advantage with this type of solution.

**Monitoring, Regulating, and Discontinuing Total Parenteral Nutrition**

**Important to Know**

Please follow your institution’s specific policies and procedures related to monitoring, regulating, and discontinuing TPN. In addition, be familiar with CLPNA’s Competency Profile (Section V) for specific competencies in this area.

Typically, the physician, along with the registered dietitian, work closely to determine the needs of the client receiving TPN. As such, the nursing team should be aware of any new or discontinued TPN orders, also liaising with the team if there are any concerns. Specific client guidelines, which detail the exact amounts of electrolytes, dextrose, nutrients, etc., in a feeding solution, will be written for anyone receiving TPN.

Before hanging the TPN solution, the registered nurse, dietician, or other health care professionals authorized to initiate TPN may collaborate with an LPN to check the components of the TPN bag against written orders. The proper IV infusion filter set should be used, and aseptic techniques must be carried out when attaching TPN to the central venous access device (CVAD). The LPN should recognize that because of the central line’s close proximity to the heart, extreme caution must be used to prevent complications (e.g., infection). Regular monitoring is important to detect and decrease chances of complications. It is essential to track the client’s response to nutritional support.

Clients receiving TPN should have their nutritional requirements reviewed regularly. The LPN takes into consideration the client’s clinical status as well as any concurrent treatments (e.g., dialysis, blood transfusion), drug therapies (e.g., antibiotics), nutritional status, response to TPN, and laboratory results.
Monitor the following for clients receiving TPN:

<table>
<thead>
<tr>
<th>Component</th>
<th>Monitor for:</th>
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<tbody>
<tr>
<td>Routine Laboratory Values</td>
<td>This includes but is not limited to the following:</td>
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<td>- Potassium (K), serum sodium (Na), serum creatinine (CK); check policy</td>
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<td>for frequency (e.g., daily versus weekly)</td>
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<td>- Calcium (Ca), magnesium (Mg), phosphate (P); check policy for frequency</td>
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<td></td>
<td>(e.g., every other day versus twice a week)</td>
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<td></td>
<td>- Trace elements (e.g., zinc, copper, selenium); check policy for frequency</td>
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<td></td>
<td>(e.g., monthly)</td>
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<td>- Folate, vitamin B12, vitamin A, vitamin E; check your policy (e.g.,</td>
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<tr>
<td></td>
<td>monthly)</td>
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<tr>
<td>Venous Access Site</td>
<td>Ensure that access site is labelled and dedicated for TPN only.</td>
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<td>Check venous access site daily to monitor for signs of infection and</td>
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<td></td>
<td>phlebitis.</td>
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<tr>
<td>Weight</td>
<td>Refer to facility policy and procedures.</td>
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<td></td>
<td>Check weight daily to monitor fluid changes.</td>
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<tr>
<td>Blood Glucose Monitoring</td>
<td>Refer to facility protocols.</td>
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<td></td>
<td>Check blood glucose initially q4–6 hours. Once stable, monitor blood sugars</td>
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<td>daily.</td>
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<tr>
<td>Fluid Balance</td>
<td>Ensure accurate input and output over 24-hour period (daily). This includes</td>
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<td>dietary intake, medications given (e.g., IV antibiotics).</td>
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<tr>
<td>Vital Signs</td>
<td>Refer to facility protocols (e.g., monitor every shift or daily).</td>
</tr>
<tr>
<td>Neurological Status</td>
<td>Check for level of orientation and level of consciousness.</td>
</tr>
<tr>
<td>Assessment of Epidermis</td>
<td>Check for changes in skin integrity, hair, nails, and the oral cavity.</td>
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</table>
Managing Side Effects and Complications Associated with Total Parenteral Nutrition

Depending on facility policies and procedures, the LPN may be required to intervene in the management of side effects and complications for persons receiving TPN. Some of these side effects also represent complications of TPN. When conducting clinical assessment of the client receiving TPN, the following possible side effects/complications may be uncovered:

<table>
<thead>
<tr>
<th>Side Effect/Complication</th>
<th>Description</th>
<th>Management</th>
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<tbody>
<tr>
<td>Sepsis/Infection</td>
<td>“Catheter-related infection and septicemia can occur in clients receiving TPN through both peripherally and centrally placed lines.”</td>
<td>“Apply strict aseptic technique during insertion, care, and maintenance.”</td>
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</tbody>
</table>
|                          | “The client receiving parenteral nutrition may be immunosuppressed and thus more susceptible to opportunistic infections. In this client, signs of inflammation or infection can be subtle, if present at all.” | “Frequently assess CVC site for redness, tenderness, or drainage. Notify health care provider of any signs and symptoms of infection.”
|                          | “Many clients receiving TPN are receiving chemotherapy, corticosteroids, or antibiotics, which can mask signs of infection.” | If infection is suspected:
|                          | Infection can also occur “due to poor aseptic technique during insertion, care, or maintenance of central line or peripheral line” | “Blood cultures are drawn simultaneously from the catheter and a peripheral vein.”
|                          | “CR-BSI, which starts at the hub connection, is the spread of bacteria through the bloodstream.” | “A chest radiograph is taken to detect changes in pulmonary status. The current TPN solution with tubing and filter should also be cultured and replaced with an entirely new setup.”
|                          | “There’s an increased risk of CR-BSI with TPN, due to the high dextrose concentration of TPN. Symptoms include tachycardia, hypotension, elevated or decreased temperature, increased breathing, decreased urine output, and disorientation.” | “A new central line may be immediately established or replaced by a peripheral route. If TPN must be discontinued abruptly, it is important that a glucose source be maintained to prevent rebound hypoglycemia.”
<p>|                          | | “Avoid hyperglycemia to prevent infection complications.” |
|                          | | “Closely monitor vital signs and temperature.” |
|                          | | IV antibiotic therapy may be required. |
|                          | | “Monitor white blood cell count and client for malaise.” |
|                          | | “Replace IV tubing frequently as per agency policy (usually every 24 hours).” |</p>
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| Ascites                  | “Ascites is a form of edema in which fluid accumulates in the peritoneal cavity; it results from nephrotic syndrome or cirrhosis.”¹²¹ | “Management of ascites is focused on sodium restriction, diuretics, and fluid removal. The amount of sodium restriction is based on the degree of ascites. The client is usually not on restricted fluids unless severe ascites develops.”
|                          |             | “There should be accurate assessment and control of fluid and electrolyte balance.”¹²² |
| Pulmonary Edema          | “Pulmonary edema is defined as abnormal accumulation of fluid in the lung tissue and/or alveolar space. It is a severe, life-threatening condition.”¹²³ | “Notify primary health care provider regarding change in condition.”
|                          | “Signs and symptoms include fine crackles in lower lung fields or throughout lung fields, hypoxia (decreased O₂ sats).” | “Client may require IV medication, such as Lasix to remove excess fluids.”
|                          | “Pulmonary edema may be more common in the elderly, young, and clients with renal or cardiac conditions.”¹²⁴ | A decrease or discontinuation of IV fluids may also occur.”¹²⁵ |
|                          |             | “The nurse also administers medications (i.e., morphine, vasodilators, inotropic medications, preload and afterload agents) as prescribed and monitors the client’s response.”¹²⁶ |
|                          |             | “Raise head of bed to enhance breathing and apply O₂ for oxygen saturation less than 92% or as per agency protocol.”
<p>|                          |             | “Monitor intake and output.”¹²⁷ |
|                          |             | “Nursing management of the client with pulmonary edema includes assisting with administration of oxygen and intubation and mechanical ventilation if respiratory failure occurs.”¹²⁸ |</p>
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<tr>
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<tbody>
<tr>
<td>Impaired Wound Healing</td>
<td>“Nutritional assessment and support of the client with a wound is a key component in normal cellular integrity and tissue repair.”&lt;sup&gt;220&lt;/sup&gt;</td>
<td>“You need to correct inadequate nutrition and support healing through early intervention.”&lt;br&gt;“The Joint Commission (2007) recommends nutritional assessment within 24 hours of admission.”&lt;br&gt;“Assess the client’s mouth and skin for signs of nutritional deficiencies.”&lt;sup&gt;221&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fluid Overload</td>
<td>“Overloading the circulatory system with excessive IV fluids causes increased blood pressure and central venous pressure.”</td>
<td>“The treatment for circulatory overload is decreasing the IV rate, monitoring vital signs frequently, assessing breath sounds, and placing the client in a high Fowler’s position. The physician is contacted immediately.”&lt;sup&gt;222&lt;/sup&gt;</td>
</tr>
<tr>
<td>Blood Clotting</td>
<td>“Blood clots may form in the IV line as a result of kinked IV tubing, a very slow infusion rate, an empty IV bag, or failure to flush the IV line.”</td>
<td>“The tubing should not be irrigated or milked.”&lt;br&gt;“Neither the infusion rate nor the solution container should be raised; the clot should not be aspirated from the tubing.”&lt;br&gt;“If blood clots in the IV line, the infusion must be discontinued and restarted in another site with a new cannula and administration set.”&lt;sup&gt;223&lt;/sup&gt;</td>
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<tr>
<td>Air Embolism</td>
<td>“Air embolus can occur during insertion of the catheter or when the tubing or cap is changed.”&lt;sup&gt;224&lt;/sup&gt; &lt;br&gt;“An air embolism may occur if IV tubing disconnects and is open to air, or if part of catheter system is open or removed without being clamped.”&lt;br&gt;“Symptoms include sudden respiratory distress, decreased oxygen saturation levels, shortness of breath, coughing, chest pain, and decreased blood pressure.”&lt;sup&gt;225&lt;/sup&gt;</td>
<td>“Having the client perform a Valsalva manoeuvre (holding his or her breath and ‘bearing down’) while assuming a left lateral decubitus position can prevent air embolus. The increased venous pressure created by the manoeuvre prevents air from entering the bloodstream during catheter insertion.”&lt;sup&gt;226&lt;/sup&gt; &lt;br&gt;“Make sure all connections are clamped and closed.”&lt;br&gt;“Clamp catheter, position client in left Trendelenburg position, call health care provider, and administer oxygen as needed.”&lt;sup&gt;227&lt;/sup&gt;</td>
</tr>
<tr>
<td>Side Effect/Complication</td>
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<td>Management</td>
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<tr>
<td>Parenteral Nutrition-Induced Liver Disease or Liver Failure (PNALD)</td>
<td>PNALD is “characterized by elevated liver tests, hepatic steatosis and progressive hepatic fibrosis that could evolve into a life-threatening disease.”&lt;sup&gt;228&lt;/sup&gt;</td>
<td>“PNALD should be suspected in all clients receiving TPN in the hospital or at home.”&lt;sup&gt;229&lt;/sup&gt;</td>
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<tr>
<td>Gallbladder Complications</td>
<td>“During total parenteral nutrition (TPN), biliary stasis and hypomotility have been well documented, contributing to the development of biliary dilation, sludge accumulation, and acute cholecystitis. In most clients, TPN induces gallbladder stasis.”&lt;sup&gt;231&lt;/sup&gt;</td>
<td>“Intravenous administration of amino acids or CCK may circumvent the biliary dysmotility associated with TPN.”&lt;sup&gt;232&lt;/sup&gt;</td>
</tr>
<tr>
<td>Hepatic Dysfunction</td>
<td>“Chronic TPN administration, usually for more than 3 months, may lead to the development of liver disease.”&lt;sup&gt;233&lt;/sup&gt;</td>
<td>“TPN-induced liver dysfunction is generally self-limited. There is no specific treatment beyond discontinuing TPN when possible. However, a few measures listed below may reduce the incidence of this issue.”</td>
</tr>
<tr>
<td>Fatty Liver Disease</td>
<td>“In adults, steatosis is the most common manifestation of TPN-induced liver disease.”</td>
<td>“Avoid early (within 1 week) initiation of TPN, even if that means ‘underfeeding’ the client.”</td>
</tr>
<tr>
<td>Jaundice</td>
<td>“The dominant manifestation of TPN-induced liver disease in young children is cholestasis.”&lt;sup&gt;234&lt;/sup&gt;</td>
<td>“Avoid excessive calories... and avoid dextrose as the sole carbohydrate.”&lt;sup&gt;237&lt;/sup&gt;</td>
</tr>
<tr>
<td>Hepatomegaly</td>
<td>Pathophysiology also includes “mild hepatomegaly with abdominal pain, along with elevated aminotransferase levels.”&lt;sup&gt;235&lt;/sup&gt;</td>
<td>“Conversion to enteral nutrition as early as possible should be the primary goal.”&lt;sup&gt;238&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cholelithiasis</td>
<td>TPN “is rarely the primary cause of postoperative jaundice... [it] is associated with significant comorbidities that may lead to postoperative hepatic dysfunction.”&lt;sup&gt;236&lt;/sup&gt;</td>
<td></td>
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<tr>
<td>Side Effect/Complication</td>
<td>Description</td>
<td>Management</td>
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</tbody>
</table>
| Convulsion or Seizure    | “Seizure precautions are initiated when hypocalcemia is severe.”<sup>239</sup>  
“When hypomagnesemia is severe, seizure precautions are implemented.”<sup>240</sup>  
“More profound hyperglycemia, however, causes hyperosmolality (seizures and coma), osmotic diuresis, and depressed immune function.”<sup>241</sup> | “To avoid hyperglycemia, glucose infusions should be limited to 5 gm/kg/day. If this proves ineffective, insulin should be added to TPN if the serum glucose remains greater than 200 mg/dL for more than 1 day.”<sup>242</sup> |
| Metabolic Imbalance       | “A variety of metabolic complications can occur during parenteral nutrition. The most common is overfeeding, which results in excess CO₂ production and occasionally hypercapnia in clients with pulmonary disease.”  
“The most serious metabolic complication of TPN is refeeding syndrome, an acute state of electrolyte balance due to initiation of nutritional support. It is most likely to occur when TPN is commenced in the severely malnourished client. Concern for this syndrome requires daily serum electrolytes initially, and often electrolyte supplementation.”<sup>243</sup> | |
<p>| Hyper/hypoglycemia       | “Hypoglycemia sometimes occurs with abrupt cessation of TPN.”&lt;sup&gt;244&lt;/sup&gt; | “To prevent, do not discontinue TPN abruptly but taper rate down to within 10% of infusion rate one to two hours before stopping. If hypoglycemia is suspected, test blood glucose level, and administer IV bolus of dextrose per physician order if necessary.”&lt;sup&gt;245&lt;/sup&gt; |</p>
<table>
<thead>
<tr>
<th>Side Effect/Complication</th>
<th>Description</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyper/hypocalcemia</td>
<td>Hyperglycemia</td>
<td>“Monitor blood glucose level daily until it is stable and then as ordered or as needed.” Follow agency policy for glucose monitoring with TPN. “TPN is initiated slowly and tapered up to maximal infusion rate.” Be alert to changes in dextrose levels in amino acids and the addition/removal of insulin to TPN solution. “Additional insulin may be required during therapy if problem persists (or if client has diabetes mellitus).” Insulin brings sugar into the cell. As this happens, potassium attaches to insulin and is brought into the cell as well. As a result, the potassium available in the blood stream will be decreased. Monitoring electrolytes, specifically for potassium, should be considered during treatment.</td>
</tr>
<tr>
<td>Nutritional Imbalance</td>
<td>There are various scenarios where the client may receive too much or too little of an element in the TPN. This can occur in the early phases as the nutritional needs are monitored and established.</td>
<td>“Electrolyte abnormalities should be corrected before starting parenteral nutrition.” “Calorie goals should be reached gradually. It is very important to base the caloric and protein needs on the client’s current weight to avoid overfeeding.” “The parenteral nutrition solution contains most of the major electrolytes, vitamins, and minerals.”</td>
</tr>
</tbody>
</table>

**Did You Know?**
Because of the high dextrose content in TPN, it is prone to microbial growth. Thus, TPN requires a separate dedicated line via a central vein. It is important to read and follow your facility’s policies and procedures related to TPN.
Summary

Total parenteral nutrition (TPN), while representing a progressive and effective treatment for many clients, presents some serious risks to the client’s health in a number of areas. It is a procedure that demands meticulous attention to detail for the nurse and requires the expertise and input of many health team members. The LPN working with TPN is required to have competence in working with central access devices and associated equipment.

Learning Activity

1. What are two types of TPN solutions?
2. Identify three conditions that would require the use of TPN.
3. What would a nutritional assessment include for recipients of TPN?
4. Explain two complications associated with TPN administration.
5. List at least three key nursing interventions while monitoring a client on TPN.

Answers

1. Three-in-one and two-in-one
2. Crohn’s disease, cancer (pancreatic), major infection, burns, trauma, etc.
3. Medical history, dietary assessment, measure height and weight, assess laboratory values, physical examination
4. Refeeding syndrome, hypoglycemia/hyperglycemia, hypo/hyperkalemia, hypocalcemia, essential fatty acid deficiency (EFAD)
5. Vital signs, monitor intake and output, assess neurological status, monitor lab values (serum albumin, total protein, electrolyte, glucose), monitor blood glucose
Module 9: Infusion Therapy for Special Populations

Introduction

This section of the course presents additional concerns with intravenous infusions in two main populations: older adults and children. In looking at the increased vulnerabilities of these clients, the additional considerations for infusion therapies are outlined. More awareness on the part of nurses can prevent further complications and injury to the client.

Outcomes

By the end of this module the LPN will be able to

- identify the differences between adults and children regarding infusion therapies;
- explain the differences in physiology that lead to increased vulnerability in older adults and children when receiving intravenous infusion therapies; and
- identify the additional considerations for older adults and children when receiving infusion therapies.

Considerations with Children

The first issue with children is that children’s fluid balances are different from adults’. Proportionately, they have far more fluid in their bodies, making up (at birth) about 90 percent and shortly after around 80 percent of their body composition.\(^{252}\) So it is easy to overload children with IV infusions and give them too much fluid all at one time. Therefore, the nurse has to be very careful that any infusion being administered is controlled and aligns with the doctor’s orders.

The second consideration is that children’s veins are vulnerable. They are smaller, and children have a lot of subcutaneous tissue under their skin, so the veins can lie deeper and be hidden and more difficult to access and observe. For this reason, butterfly needles are often used for infusions.\(^{253}\) The butterfly needle gets connected to the infusion tubing so that infusions can be given. This system is used in intermittent infusions, not in continuous infusions. With continuous infusions, the gauge of the catheter needs to be between 21 and 25 (smaller than an adult would have) to match the child’s smaller veins. The principle is that the smallest possible gauge and the smallest possible length of catheter should be used with children to minimize trauma to the veins.\(^{254}\)

The third point to be considered is that children’s immune systems are immature and if children are ill already, their immune systems may also be weakened. This increases the risk of infection from intravenous infusions and central lines.

Regarding central lines, the consideration about what device to use is based on the child’s diagnosis, the risk of injury to the veins on insertion, the duration of the therapy that is being proposed, and the child’s and family’s abilities to care for the device, especially if the child is going home. Central devices can be chosen when the child lacks suitable veins peripherally or two attempts have been made unsuccessfully in accessing those veins. A central line would be chosen if the child requires intravenous fluids or medications for more than three to five days or if the fluid or medication that he or she is to receive is either an irritant to the veins or a concentrated solution that requires rapid dilution. Using central lines also avoids repeated IV starts, since children’s peripheral veins can often collapse or run into problems or complications.\(^{255}\)
In children, the risk of occlusion and thrombosis may be greater due to the slower infusion rates that are used and the smaller gauges of devices. This must be balanced so that the infusion rate is sufficient to prevent thrombosis or occlusions from occurring. Occlusion is also possible in peripheral devices, since children tend to move a lot and may get the line caught underneath them.

Infiltration in children, of either device, leads to greater damage than it would in adults, since the veins are more vulnerable and the area over which the infiltration occurs is wider. Infusion pumps and syringe pumps can be used so that the amount and rate of fluid administered is controlled. This also avoids fluid overload. If medications are being infused, a small amount (e.g. the amount required for one to two hours of infusion) can be loaded into the infusion chamber or into a syringe pump and then it will be infused in two hourly batches. This avoids fluid overload if something goes wrong with the pump or something happens to the line that causes the fluid to be inserted over a shorter time.

The fluid to be administered to a child is based on the child’s weight. The nurse must calculate based on this formula:

- 100 mL/kg of body weight for the first 10 kg
- 50 mL/kg of body weight for the next 10 kg
- 20 mL/kg of body weight for the remainder of the body weight in kg

Using this formula, the nurse can calculate the amount of fluid that is required for any given child on a 24-hour basis. The amount is divided by 24 hours to determine the hourly infusion rate, and thus the child’s requirement for fluids should not be exceeded.

In deciding where to place an infusion in children, there are more sites available than with an adult. They can often be inserted into the femur, foot, or hand, and in neonates and young children, the scalp veins can also be used. This is because these veins are nearer the surface and very easy to access. The non-dominant extremity should be used in children if it is available and there are no other complications associated with it (e.g., a cast).

The nurse should discuss with the parents and the child (age appropriate) about the procedure and the pain associated with the insertion.

When securing lines, use a minimal amount of tape on young children to avoid irritation or damage to the skin. Further, it is important to monitor children’s fluid output to ensure that their kidneys are functioning to a level that will tolerate the infusion. The normal expectation is 1 to 2 mL/kg per hour. According to Ateah, Scott, and Kyle, normal saline has been found to be less irritating as a flush for intravenous lines, and it is also more compatible with more solutions and medications in comparison to heparin. They suggest that normal saline be used for most flushes unless there is a specific reason for using heparin.

The nurse should also take account of the child’s emotional development when inserting and managing intravenous infusions. The child may be fearful of the procedure or the equipment and may need pain medication in advance of the insertion. Therapeutic play or distraction techniques can also be used at the time of insertion or any time when the child demonstrates fear regarding the equipment.

The following suggestions may assist a child in coping with the insertion of an IV:

- Taking deep breaths, gentle blowing, or talking
- Looking at a book, movie, or bubbles
- Counting, singing, spelling, or playing a cognitive game
LPNs need to be diligent to anticipate any indication of complications arising due intravenous therapy.

The nurse needs to conduct more frequent observations on children to anticipate complications before they occur.

Older Adults

In older adults, the aging process changes the physiology of the body such that skin is thinner, is less elastic, and has less subcutaneous tissue under it. This creates several problems regarding intravenous infusions in that the blood vessels tend to be more mobile, and therefore it can be difficult to access them with an intravenous catheter.262 Also, older adults lack the amount of fluid reserves that younger adults have. Total body water is reduced by 6 percent in older adults.264 Another problem with accessing blood vessels and maintaining intravenous infusions is that blood vessels (veins especially) may be sclerosed and difficult to work with. Also, due to sclerosis it may be more difficult to deal with occlusion and the possibility of thrombosis. The skin is more prone to bruising, and when accessing the site, or even during transfusion, if bleeding occurs under the skin, it spreads out over a large area and damages other blood vessels, reducing the number of sites that are available for intravenous infusion.265 Thus, with all these complications including — vein tears and blown veins — large-scale bruising is a more frequent risk in the older adult.

An older person is more likely to have medical problems—potentially multiple medical problems—and a weakened immune system. This puts them at a higher risk for infection than younger adults. Aseptic technique must be meticulous during insertion and throughout the therapy to avoid introducing bacteria of any kind into the administration tubing or into the bloodstream. Further, when the health care provider initiating the IV site uses too much friction or taps on the veins too much, it may cause damage to the fragile skin, losing the potential of a viable site. This can also open up the possibility of bacterial invasion.266

As with children, the smallest catheter possible to achieve the goal is the one that should be used.267 The client’s lungs should be assessed (auscultated) on a frequent basis, as this might be the first sign of fluid overload in an elderly client. If crackles are heard, this indicates that there is fluid in the lungs. However, this will also need to be weighed against the client’s condition. For example, if the client has a respiratory infection or pneumonia, they may already have crackles in their lungs.

Renal function is another major issue in the elderly. Since this will be a critical component of intravenous infusion, the nurse needs to monitor the client’s fluid output and intake to measure the balance on a daily basis and to identify fluid overload or fluid retention.268 If the client has edema, this needs to be identified in advance of the infusion. If the client starts to develop edema after the infusion is started, this might be another indication of fluid overload. The client’s cardiovascular function should be assessed in advance of the infusion, because if there is any compromise in the cardiovascular system, it will lead to fluid overload and edema, and ultimately to more serious problems.

In addition, the more intact the dressing site for central and peripheral infusions, the less frequent that dressing changes are required, the less potential there is for damage or injury to the client’s skin, and the less potential for compromising the infusion.
Summary

Intravenous infusions are commonplace among older adults and children whose health is compromised. Sometimes they are the treatment method of choice, given other physiological, growth, or developmental vulnerabilities. However, both populations present unique challenges and considerations that the nurse must take into account when providing nursing care. This module has outlined these challenges in relation to intravenous infusion therapies. With close attention to these considerations, the nurse can provide safe care to both groups.
Module 10: Health Teaching and Coaching, Client Concerns and Documentation

Introduction

In this section of the course, we discuss the issues of health teaching and coaching, addressing client concerns, and completing nursing documentation in relation to various infusion therapies. Many aspects of these activities are similar for all infusion therapies; however, there are additional aspects for each type of infusion. Since infusion therapies happen in various contexts—hospitals, day clinics, home care (or at least many clients go home with active infusions and central lines or implants)—the health team must include the client, as he or she will be the first observer and reporter of concerns. The client and family members also need to be able to perform care and maintenance of the infusion that was previously in the domain of health care practitioners. In addition, documentation requirements in infusion therapies are both extensive and critical to the outcomes. Attention to detail and accuracy in recording are two components with which clients, and some nurses, need assistance.

Outcomes

By the end of this module the LPN will be able to

- explain the teaching/coaching nursing function regarding infusion therapies;
- outline the importance of attending, in a timely and comprehensive manner, to client concerns about their infusion therapies; and
- generate a list of nursing documentation requirements for the infusion therapies included in this course.

Health Teaching and Coaching

Throughout this course, we have referred to the ongoing need to educate clients and their families about their infusion therapies and to engage them in the monitoring process. The client is the best source of early warning for impending complications and thereby assisting the health team in maintaining the client’s safety. The nurse’s constant observation and assessment of the client compels the nurse to engage in a relationship that is the source of this key data for critical analysis. When the nurse responds to the client’s concerns throughout the procedures and infusions, the client knows that the nurse can be trusted and is therefore more likely to report early warning signs and changes in his or her health status to the nurse. This, in turn, facilitates early intervention by the nurse, thus preventing and minimizing complications and their effects.

The client must know the details of the specific therapy to be able to participate, yet the information must not overwhelm him or her. Here are some examples of the types of information the client needs:

- “Catheter placement, purpose, and common complications that may be experienced and the need to immediately report complications.
- Pain management, including the action of medications that will be used and the side effects that may be experienced.
- The need for immediate and early reporting of pain. Instruct the client how to use a pain intensity scale to report the pain.
• The need for immediate reporting of any side effects. Emphasize the importance of reporting any changes (that are specific to the particular infusion therapy the client is receiving).
• Who will administer and monitor the infusions and medications.
• Advise client as to an appropriate activity level during and after the infusion. Caution client to also restrict activity to that which is appropriate relative to the underlying condition.
• Prepare the client for any variations that may occur (e.g., pain, mobility) once the infusion is discontinued.269

Review all the following client education materials and resources (for infusion therapies) provided by the Alberta Government and AHS at their jointly produced website:

- https://myhealth.alberta.ca/alberta/Pages/Blood-transfusions.aspx
- https://myhealth.alberta.ca/alberta/Pages/Blood-transfusions-for-children.aspx
- https://myhealth.alberta.ca/alberta/Pages/Blood-transfusions-for-babies.aspx
- https://myhealth.alberta.ca/Alberta/Pages/systemic-treatment-information.aspx

(On this site watch [Baxter Infusor]

Instructional Video to see the various forms of central line.)

One cannot overemphasize the importance of teaching and coaching clients in the modern health care environment. In the case of infusion therapies, with all their vagaries, this aspect of nursing care can be literally life-saving.

Documentation

Documentation is a critical function of nursing practice, as has been demonstrated in previous CLPNA online courses. (For a comprehensive resource on documentation see CLPNA’s Nursing Documentation 101 course. Throughout this course, we have seen the extent of documents and documentation that is required for safe delivery of infusion therapies to clients. This part of the section involves completion of the following learning activity.

Summary

This module addresses some critical issues in relation to infusion therapies. Due to the serious risks and complications that can occur, educating clients and families is an important function that can save lives. Involving the client in awareness of effects, side effects, and pending or actual complications recognizes their role as vital members of the health team and provides nurses with a key source of information and assessment data. Perhaps even more crucial is the accurate documentation of every aspect of infusion therapies. There are many forms of documentation to consider in this area of practice, and each of them provides assessment data and tracking of the infusion from beginning to end. All this—teaching and documenting—supports the goal of client safety before, during, and after each infusion therapy.
Learning Activity

Use the following table to refer to the various modules of this course. Complete the missing data in the table with the appropriate nursing documentation requirements by filling in each corresponding box. The information you need to complete this activity is contained in the course and referenced resources.

<table>
<thead>
<tr>
<th>Infusion</th>
<th>Type of Document to Be Completed</th>
<th>Content to Be Included in Document</th>
<th>Timing of Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PICC Line</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood Transfusion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spinal / Epidural</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Answers

<table>
<thead>
<tr>
<th>Infusion</th>
<th>Type of Document to Be Completed</th>
<th>Content to Be Included in Document</th>
<th>Timing of Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral</td>
<td>IV fluids administration record</td>
<td>Amount and type of fluid administered, time of administration— start and end</td>
<td>Commencement of infusion and completion of bag</td>
</tr>
<tr>
<td></td>
<td>In- and-out fluid chart</td>
<td>Amount, time, type</td>
<td>Time of administration of fluids</td>
</tr>
<tr>
<td></td>
<td>IV dressing/ tubing</td>
<td>Date, time applied, initials</td>
<td>At time of commencement</td>
</tr>
<tr>
<td></td>
<td>IV medications record</td>
<td>Client, drug, dose, date, time, amount in bag, type of fluid</td>
<td>Immediately after administering</td>
</tr>
<tr>
<td></td>
<td>Labels for minibag</td>
<td>client, drug, dose, date, time: start and end, initials</td>
<td>Prior to hanging bag</td>
</tr>
<tr>
<td></td>
<td>MAR</td>
<td>Sign for ordered medications given</td>
<td>Immediately after administering meds</td>
</tr>
<tr>
<td></td>
<td>Health record</td>
<td>Prior client assessment, administration of medication, post-admin assessment and monitoring, complications, interventions to ameliorate (nursing process), client and family teaching</td>
<td>As close to administration and assessments/ interventions as possible</td>
</tr>
<tr>
<td>Infusion Type</td>
<td>Type of Document to Be Completed</td>
<td>Content to Be Included in Document</td>
<td>Timing of Documentation</td>
</tr>
<tr>
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<td>-----------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>PICC Line</td>
<td>IV fluids administration record</td>
<td>Amount and type of any fluid administered, time of administration— start and end</td>
<td>Commencement and completion of infusion</td>
</tr>
<tr>
<td></td>
<td>In- and-out fluid chart</td>
<td>Amount, time, type</td>
<td>Time of administration of fluids</td>
</tr>
<tr>
<td></td>
<td>Site dressing/tubing</td>
<td>Date, time applied, initials on a label and attached</td>
<td>At time of commencement</td>
</tr>
<tr>
<td></td>
<td>IV medications record</td>
<td>Client, drug, dose, date, time, amount, and type of fluid in bag</td>
<td>Immediately after administering</td>
</tr>
<tr>
<td></td>
<td>Labels for bag</td>
<td>Client, drug, dose, date, time (start and end), initials</td>
<td>Prior to hanging bag</td>
</tr>
<tr>
<td></td>
<td>MAR</td>
<td>Sign for ordered medications given</td>
<td>Immediately after administering meds</td>
</tr>
<tr>
<td></td>
<td>Health record</td>
<td>Insertion site, observations of site and equipment, total length of catheter, length of catheter inserted, client assessment and monitoring, administration of medication, post-admin assessment and monitoring, complications, interventions to ameliorate (nursing process), client and family teaching</td>
<td>As close to administration and assessments / interventions as possible</td>
</tr>
<tr>
<td>Infusion Type</td>
<td>Type of Document to Be Completed</td>
<td>Content to Be Included in Document</td>
<td>Timing of Documentation</td>
</tr>
<tr>
<td>---------------</td>
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<td>------------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Blood Transfusion</td>
<td>Consent form</td>
<td>Client name, date, physician name, procedure</td>
<td>Prior to commencement of transfusion; in emergency situation, as close to commencement of transfusion as possible</td>
</tr>
<tr>
<td>Blood Transfusion</td>
<td>Blood transfusion record</td>
<td>Amount and type of blood/blood product administered, time of administration (start and end)</td>
<td>Commencement and completion of transfusion</td>
</tr>
<tr>
<td>Blood Transfusion</td>
<td>In- and-out fluid chart</td>
<td>Amount, time, type</td>
<td>Time of administration of fluids</td>
</tr>
<tr>
<td>Blood Transfusion</td>
<td>Site dressing/tubing</td>
<td>Date, time applied, initials on a label and attached</td>
<td>At time of commencement</td>
</tr>
<tr>
<td>Blood Transfusion</td>
<td>Health record</td>
<td>Consent conversation with physician</td>
<td>Check that this has been documented in the health record before the transfusion is started</td>
</tr>
<tr>
<td>Blood Transfusion</td>
<td>Health record</td>
<td>Consent or refusal given</td>
<td>As close to administration and assessments/interventions as possible</td>
</tr>
<tr>
<td>Blood Transfusion</td>
<td>Health record</td>
<td>Start and stop date and time of the transfusion</td>
<td>Prior to commencement of transfusion</td>
</tr>
<tr>
<td>Blood Transfusion</td>
<td>Transfusion service form</td>
<td>Type, volume, and transfusion service identification number of the blood component or product</td>
<td>Immediately after commencement of transfusion</td>
</tr>
<tr>
<td>Blood Transfusion</td>
<td>Transfusion record</td>
<td>Identification of the person performing the transfusion</td>
<td>Immediately after commencement of transfusion</td>
</tr>
<tr>
<td>Blood Transfusion</td>
<td>Transfusion record</td>
<td>Identification of the second person who verified the blood component or product for transfusion</td>
<td></td>
</tr>
<tr>
<td>Blood Transfusion</td>
<td>Client health record</td>
<td>All additional vital signs and time they were captured</td>
<td>As they are recorded</td>
</tr>
</tbody>
</table>
| Transfusion documentation/tag | Any signs and symptoms of adverse reaction and subsequent follow up  
| Client teaching performed  
| Follow up testing done/Client outcome | At the time of observing  
| | After teaching completed  
| The transfusion documentation/tag is returned to the laboratory by the means provided by the facility—manual or electronic | After transfusion completed  
| Notification record | Client notification  
<p>| All inpatients must be notified they have received a blood component or blood product; become familiar with the mechanism of notification of transfusion in your hospital | On completion of the transfusion |</p>
<table>
<thead>
<tr>
<th>Infusion</th>
<th>Type of Document to Be Completed</th>
<th>Content to Be Included in Document</th>
<th>Timing of Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal / Epidural</td>
<td>Consent form</td>
<td>Client name, date, physician name, procedure</td>
<td>Prior to commencement of injection or infusion.</td>
</tr>
<tr>
<td></td>
<td>Site dressing/catheter</td>
<td>Date, time inserted, initials on site dressing, catheter total length and length inserted</td>
<td>Time of administration</td>
</tr>
<tr>
<td></td>
<td>Medications infusion record</td>
<td>Client, drug, dose, date, time, amount, and type of fluid in bag</td>
<td>At time of commencement</td>
</tr>
<tr>
<td></td>
<td>Labels for bag</td>
<td>Client, drug, dose, date, time (start and end), initials, labelled “epidural” or “spinal”</td>
<td>Immediately after administering</td>
</tr>
<tr>
<td></td>
<td>MAR</td>
<td>Sign for ordered medications given</td>
<td>Immediately after conducting assessment</td>
</tr>
<tr>
<td></td>
<td>Pain assessment tool(s)</td>
<td>Pain level, onset, quality, duration</td>
<td>Hourly, then every two hours, then every four hours</td>
</tr>
<tr>
<td></td>
<td>Sedation scale</td>
<td>Level of consciousness, depth of respirations</td>
<td>Immediately after administering meds</td>
</tr>
<tr>
<td></td>
<td>Health record</td>
<td>Insertion site, observations of site and catheter, total length of catheter, length of catheter inserted</td>
<td>As close to administration and assessments/interventions as possible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Client assessment and monitoring prior to administration of medication, post-admin assessment and monitoring, complications, interventions to ameliorate (nursing process), client and family teaching</td>
<td></td>
</tr>
</tbody>
</table>
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83 Day et al., *Brunner & Suddarth’s* 340.
Day et al., Brunner & Suddarth’s.

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De Biasio, “Blood Administration.”


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