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Successful Infusion Therapy in Older Adults

ABSTRACT

Older adults are a special patient population who require attention to a variety of issues and considerations related to infusion therapy. The need to alter practice approaches includes vascular access techniques and the administration of intravenous medications, fluids, and blood components. In addition, older adults will manifest very different signs and symptoms related to development of an infection in the body. This article reviews the normal physical changes that occur in their major body systems and discusses recommendations to accomplish successful venous access and correct administration of infusates.

Key words: aging population, challenging veins, elderly, geriatric, geriatric practice, hypodermoclysis, older adult, physiologic aging, rolling veins, special patient population

OVERVIEW OF THE AGING POPULATION

People who live beyond the age of 60 experience the aging process. Each individual, however, is unique, and her or his rate of physical change will vary depending on many factors. Recognition of older adults as a special patient population cannot wait. Current statistics indicate that by the year 2020, 1 in 5 Americans will be over the age of 65, and the *old-old* population (people 85-100 years old) will increase dramatically.[1] Previously, *geriatric practice* was used to identify the area of health care related to patients over the age of 65. In recent years, *older adult* has become the preferred terminology. The term *older adult* creates increased recognition that each person is an individual and ages differently. Contemporary older adults are generally more active, consume a healthier diet, and may be in better health than previous generations. As a result of advances in medicine, improved nutrition, and a shift toward improved self-care—such as exercise, socialization, and stress management—the majority of today's older adults are in better physical condition, are more diverse, and will live longer than previous generations. Age groups for older adults are now delineated as follows[1]:

- Young-old: 65 to 74 years
- Middle-old: 75 to 84 years
- Old-old: 85 to 100 years and older

According to the US Department of Health and Human Services' Administration on Aging (AOA), by the year 2050 life expectancy for men is projected to be 86 years and for women 92 years.[1] Centenarians, those older than 100 years, are the fastest-growing group of older adults, according to the AOA.[1]

Additional considerations related to the older adult population include the following:

1. Approximately 80% of people over the age of 65 have at least 1 chronic health condition.[2]
2. The majority of adults who have chronic diseases, however, are still functional and active.[2]
3. Seventy percent of the physical decline that occurs with aging is related to modifiable factors such as smoking, poor nutrition, and lack of exercise.[2]

Despite the documented chronic health issues noted above, the vast majority of older adults remain functionally independent throughout their lives.

Predictable physiologic changes are influenced by many factors, including genetics, general health and self-care, the presence of disease, or lifetime traumatic events. For example, a person who has had diabetes and is noncompliant with dietary recommendations, which results

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The author has no conflicts of interest to disclose.

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DOI: 10.1097/NAN.0000000000000196

in chronic elevated blood sugar, is more likely to have altered vessel integrity as a result of microcellular inflammatory process and increased thrombogenicity in the vasculature.[3] These patients present a greater challenge for intravenous (IV) access than diabetic patients who diligently comply with recommended diets and maintain a normal range of blood sugar. Multiple traumas or illnesses over a lifetime also may hasten the baseline physical aging process. It's likely that someone who has required numerous hospitalizations and surgeries and/or has had frequent venous access for IV infusions will be depleted or limited in peripheral, deep, and central veins. Venous access in these older adults may be challenging.

BASELINE PHYSIOLOGIC AGING

Current knowledge emphasizes that the aging process is highly individualized and can be modified by lifestyle choices. However, many of the physical changes that occur with aging generally begin between the ages of 60 and 65. The following is an overview of physical changes in aging body systems that have an impact on the practice of infusion therapy, and practice recommendations to achieve the best outcomes.

The Integumentary System

The aging process initially may be apparent in a person's skin, hair, and nails. Thinning or loss of hair, hair color changes, the appearance of hyperpigmented areas on the skin, or the occurrence of fine lines and wrinkles are all visible signs of aging.[4] Many other changes gradually occur in this system that have an impact on the insertion of short peripheral catheters (SPCs). In general, the epidermis progressively thins with advancing age, and by age 80 to 90 the skin may become extremely thin[2,4,5]; this is often referred to as "tissue-paper-thin skin" (Figure 1).

Thinning skin creates reduced resistance when passing an IV catheter through the skin for venipuncture. If the epidermis is extremely thin, the use of excess force when inserting a needle for blood collection or the placement of a catheter may cause the device to transect the underside of the vein, causing loss of vein access. When inserting an IV catheter, the skin should be entered with a reduced amount of pressure to accommodate thinning skin.

When the skin of an older adult is thin and fragile, skin tears can occur easily. Applying a skin protectant or barrier before application of adhesives can add protection at the time of dressing removal. The correct removal of tape and hub securement devices used on vascular access devices (VADs) is important to avoid painful skin tears. Always use adhesive remover or alcohol to loosen and remove any securement tape or device when working with older adults.

Occasionally, the skin of an older adult may become thick and leathery, especially when he or she has spent many years working outdoors or engaging in activities such as sunbathing. Figure 2 shows this effect on the skin of a person who worked in farming for more than 50 years. This person's skin would be more resistant to the entry of a needle or IV device and would require increased force to enter the skin for a venipuncture. A focused assessment of the skin's texture and condition provides valuable information before venipuncture on older adults.

Another major change in the integumentary system is a predictable subcutaneous fat loss of about 20% in the dermis.[2,4,6] The loss leads to less stability of the veins in the tissue and what is often termed *rolling veins*. Using firm traction or vein stabilization with the thumb of the health care provider's nondominant hand positioned 1.5 to 2 inches below the venipuncture area on the vein itself will help secure a vein for venipuncture. Various approaches for vein stabilization have been profiled to secure a vein before venipuncture. However, the majority of skilled infusion nurses use this technique. Figure 3 shows the correct position of the nondominant thumb well below the

Figure 1 Extremely thin skin on the forearm of an older adult. (Copyright 2015, Infusion Knowledge, Inc. Used with permission.)

Figure 2 Thick, leathery skin occurs with prolonged exposure to outdoor activities. (Copyright 2015, Infusion Knowledge, Inc. Used with permission.)

Figure 3 Application of firm skin traction at least 1.5 inches below a venipuncture site to stabilize the vein. (Copyright 2015, Infusion Knowledge, Inc. Used with permission.)

projected point of needle entry to avoid device contamination, and the use of firm pressure to secure the vein in place.

Achieving a successful venipuncture on the first attempt should be every nurse's goal. Using proven techniques for vein stabilization and access will facilitate the insertion of an IV catheter in an older adult often on the first attempt, reducing the trauma often associated with infusion therapy.

The Venous System

As a person ages, the veins in the body remain functional. However, certain predictable changes can create major challenges for vein access. Two layers of the vein, the tunica intima and the tunica media, thicken and fibrose with aging, making the vein wall difficult to enter[2,4]; for example, the larger veins of a 95-year-old (in the old-old group) may seem rigid and even sclerotic when venipuncture is attempted because extensive physiologic changes have occurred. This type of vein often will appear prominent and rope-like, and is a poor choice for IV catheter insertion. Accessing these veins can be difficult, and despite successful access, the infusion may not run correctly because of the vein's condition. The valves in the vein also tend to become more rigid and sclerotic, increasing resistance to IV catheter advancement in the vein lumen. Moderate- to small-size veins may become more fragile[5] and even rupture with venipuncture, especially if a tourniquet has been applied too tightly. Proper tourniquet application, using less tension when placing the tourniquet for venipuncture or deciding not to use a tourniquet, will help avoid vein rupture with device entry. If no tourniquet is used, the arm should be positioned in a dependent position to accomplish vein distention. Moderate-size veins in the forearm generally are a good choice for IV catheter placement in an older adult. Placing the IV catheter away from points of flexion in the forearm—such as the back of the hand, wrist joint, or antecubital area—will help prolong the dwell time of the IV device. The bones in the forearm create a natural splint for the IV site, and the forearm is a comfortable location for IV placement in general.

Vein distention may take longer in older adults because of many variables. Low blood pressure, dehydration, and less vein elasticity all contribute to slower blood pooling in the veins, as well as reduced prominence of veins. Completely filling the vein with blood may take 30 to 40 seconds for older adults compared with 5 to 10 seconds for younger adults. Rapid release and reapplication of the tourniquet may be needed every 45 to 60 seconds to avoid overstressing the vein wall and to maintain blood pooling in the veins before venipuncture. Avoid slapping a vein in an effort to achieve vein profile. This may cause the vein to rupture and result in a painful hematoma. Tapping on the vein very lightly or applying digital pressure along the vein pathway to identify the vein is the best approach.

Selecting the most appropriate gauge when inserting an IV catheter in an older adult is important. Many older adults may have small fragile peripheral veins for a variety of reasons, most often because of standard physiologic changes. The selection of the smallest-gauge catheter to accomplish the therapy is the ideal choice.[7] Small-gauge SPCs, both 22- and 24-gauge, are available from a variety of manufacturers. A documented potential flow rate of 28 to 37 mL/min is listed by 1 manufacturer for multiple types of 22-gauge SPCs.[8] Thus, a 22-gauge IV catheter inserted into a healthy vein can potentially deliver more than 2100 mL/h. In addition, the delivery of blood components, such as red blood cells, will infuse successfully through a 22- or even a 24-gauge catheter, according to published data.[9] The use of a 22- or even a 24-gauge IV catheter in an older adult will help reduce trauma related to infusion therapy and increase a nurse's success rate on the first attempt.[6]

The practice of inserting the largest IV catheter possible for routine delivery of fluids, blood, or medications is no longer valid.[7] There are now innovative catheter designs available that will allow a 22-gauge IV catheter to be inserted for computed tomography angiograms. The fenestrated catheter tip delivers contrast media through a 22- or 24-gauge catheter and provides successful imaging of body structures.[8]

When inserting an IV catheter into an older adult, the angle used to enter through the skin and vein wall is lower because of the loss of subcutaneous fat, which makes veins more superficial. Typically, an angle of 5 to 15 degrees is best to avoid nicking or transecting the underside of the vein wall, versus the 10- to 20-degree angle that is generally recommended for the superficial veins in younger adults. Once a blood return is seen, the catheter should be lowered more, about 5 degrees, and

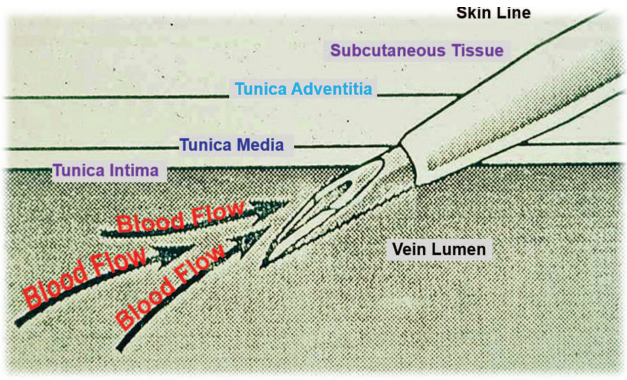

Figure 4 Image demonstrating IV catheter stylet position with initial entry into a vein. (Copyright 2015, Infusion Knowledge, Inc. Used with permission.)

advanced into the vein lumen one-eighth to one-quarter of an inch before attempting catheter threading to position the catheter correctly within the vein lumen. Figures 4 and 5 indicate the position of the catheter on the device stylet, the vein layers, the internal lumen of the vein, and the final position of the catheter tip when the device is lowered and advanced slightly after a blood return is achieved. Careful attention to all procedural steps when inserting an IV catheter into the vein of an older adult will facilitate increased success for SPC insertions. Too often, older-adult patients endure multiple attempts to insert an SPC. Implementing current evidence-based practice will help reduce the trauma of infusion therapy for all patients, including older adults.

The placement of an IV catheter with a longer dwell time may be needed in older adults when 2 to 6 weeks of infusions are ordered. A midline or peripherally inserted central catheter (PICC) can be inserted to reduce the trauma related to multiple restarts and contain the cost of care. According to the Centers for Disease Control and Prevention, a proactive approach to vascular access should be used for infusions projected to last longer than 6 days, by placing a catheter with a long dwell time.[10] A midline catheter has a typical dwell time of 2 to 4 weeks and is frequently placed for 10 to 21 days of IV antibiotics.

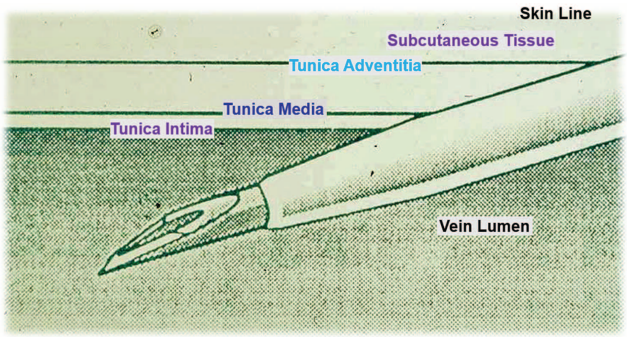

Figure 5 Image demonstrating IV catheter and stylet position once the device is lowered and advanced to position IV catheter into vein lumen. (Copyright 2015, Infusion Knowledge, Inc. Used with permission.)

Consideration must be given to the characteristics of the infusate—whether it is an irritant, a vesicant, of extreme osmolality, and being administered through a midline catheter—assess the device frequently for signs and symptoms of complications, such as chemical phlebitis or thrombus formation.[7,11] Antibiotics or anti-infectives with nonirritating or nonvesicant properties currently are indicated to be acceptable to infuse into midline catheters.[7] When infusions are needed for continuous vesicant therapy, parenteral nutrition, or infusates with an osmolality more than 900 mOsm, a central vascular access device (CVAD), such as a PICC, is the appropriate choice for venous access.[5,7] The dwell time of a PICC is unknown when it is free of complications, and it would be the ideal catheter for an older adult who has been diagnosed with cellulitis or osteomyelitis, when the projected duration of therapy for IV anti-infectives is uncertain.

A surgically implanted venous port frequently will be placed when a patient is diagnosed with cancer and is prescribed chemotherapeutic agents. The delivery of vesicant chemotherapy agents through a central venous device is recommended for patients with fragile veins to avoid extravasation.[5] Any CVAD, such as a PICC, a nontunneled central vascular catheter, or an implanted venous port, will need to be assessed for patency before infusing any medication or fluid. The current standard of practice indicates that the patency of a CVAD is verified by the ability to flush the device and the visualization of a free-flowing blood return.[7,12-14] When patency is verified before the use of any CVAD, the risk of infusate extravasation is greatly reduced, and older patients are protected from the potentially devastating consequences of a vesicant agent destroying tissue in the area of device entry.[12-14]

The Immune System

Immune function decreases with aging. Various aspects of the immune response are affected and create an altered presentation when an infection occurs in an older adult. Generally, there is a decrease in the responsiveness and strength of cell-mediated immunity, and the production of antibodies in response to antigens is slower.[2,15] The thymus gland decreases in size and function as a person ages, causing a reduction in the number of T cells produced, a decline in responsiveness to antigens, and diminished function, making older adults more susceptible to infection.[4,15]

After age 70, there is a decline in the function of the bone marrow, which further decreases the number of lymphocytes.[2] The release of endotoxins and interleukin-1 by macrophages into the bloodstream after phagocytosis of invading organisms is the trigger for temperature elevation.[16] It is physiologically impossible for an immune-compromised person, such as an older adult, to

demonstrate a fever as an initial sign and symptom of infection. In fact, an older adult may not develop a fever until the third or fourth day of an infectious process, and at that point may be at risk for septic shock. More subtle signs of infection will be seen initially, such as lethargy, slight confusion, and loss of appetite.[2,15] Traditionally, these are the physical indications of an existing infection in an older adult. These signs and symptoms are well recognized by gerontologists and health care providers who are aware of the specific differences in older adult patients. Evidence-based data offer an additional physiologic indicator, which can easily be assessed by the provider and nurses: elevated blood sugar.[17]

When an infection is present in the body, stress hormones such as cortisol are released. The elevation of cortisol in the body creates a loss of potassium. Because a loss of potassium tends to reduce the production and release of insulin from the pancreas, a person's blood sugar may rise above normal range.[17] Performing a capillary blood sugar check when these signs and symptoms are present could help identify an infection before the traditional sign of a fever is present and prevent admission to an intensive care unit for treatment of septic shock.

In addition to monitoring older adults for altered signs and symptoms of infection, using proper aseptic technique in infusion therapy is imperative. Correct aseptic technique includes:

1. Proper skin preparation before any venipuncture for peripheral catheter placement or blood collection[6]
2. Proper IV tubing and infusion system management to maintain sterility and integrity of the system, avoiding "looping" IV tubing or contamination of the patient end of tubing[18]
3. Use of maximal sterile barrier precautions for the insertion of CVADs[11]
4. Monitoring all VADs for signs and symptoms of infection or complications[8,11]

Adherence to best practice for aseptic technique will help protect older adult patients who receive infusion therapy in any care setting.

The Hepatic System

Baseline changes that occur with aging of the hepatic system affect drug pharmacokinetics the most. Protein synthesis and drug metabolism are 2 of many liver functions affected. The liver decreases in size and tissue mass, blood flow to the liver declines, and the process of "first-pass" drug metabolism decreases.[2,4,15,19,20] Drug metabolism also may be less efficient. Serum albumin decreases in relation to diminished liver function and potentially altered nutrition.[2,4,15,19,20]

The main outcome of these combined changes is a prolonged level of drug in the bloodstream, compounded by a potentially higher amount of drug in the plasma. A higher amount of drug may exist in the plasma of an older adult because fewer protein-binding sites are available, which can result in what has been called a "free drug" in the plasma. Free drug in the plasma may cause an elevated amount of drug in the blood, which can cause higher drug concentration in the body tissues and risk to older adults.[2,4,15] Adverse drug reactions or increased drug effects may occur. Unexpected neurologic reactions also may be seen as a result of a possible increase in the permeability of the blood-brain barrier, which allows some drugs to cross into the central nervous system.[2,4] Aging livers will metabolize drugs more slowly and create a longer drug half-life.

These factors make it necessary to reduce the amount of drug given to older adults and to have prolonged dosing time frames to avoid an excess amount of drug in the body and the risk of drug-related adverse effects or toxicity. Close monitoring for signs and symptoms of drug toxicity is needed, as is notification of the provider, if adverse reactions occur. Some references also indicate that the increase in body fat as a person ages and a decrease in muscle mass will have an effect on drug "volume of distribution."[2,19,20] When fat-soluble drugs are given to older adults, the increased volume of distribution can create a lengthened duration of action, as well as slowed elimination.[19,20] A reduction in drug dosages, prolonged dosing time frames, careful patient monitoring, and teaching older adults what signs and symptoms to report will help avoid adverse drug events in older adults.

The Renal System

According to Tabloski,[2] an 85 year old has about 50% less renal function than a 30 year old. By age 90, there is a decrease of 20% to 30% in the size of the kidneys and a potential reduction in the number of glomeruli in the kidneys of 30% to 50%. A decrease in glomerular filtration rate occurs. There is reduced blood flow to the kidneys, and there is sclerosing and fibrosing in the glomeruli.[2,4,15] Although the kidneys usually remain effective as a person ages, the baseline physical changes that occur with aging have a direct impact on IV fluid delivery.

First and foremost, the rate of delivery for IV fluids is reduced to avoid circulatory overload.[2] A reduced rehydration rate for older adults has been recommended by Whitehouse.[21] That many older adults may have IV fluids initiated or administered at a rate of 125 mL/h until they suffer circulatory overload is an indication of a lack of knowledge of special care factors for older adults. To prevent undue trauma, the need for IV diuretics, or prolonged hospitalizations for patients older than 70, a routine rehydration rate of no more than 80 to 100 mL/h would be appropriate, considering that reduced kidney function is known to occur with aging.

An alternative hydration method of hypodermoclysis also could be considered. The infusion of 1 L of isotonic

fluid into the subcutaneous tissue of the thighs or lower abdomen over 12 to 24 hours has proven effective in cases of mild to moderate dehydration.[6,22,23] Select medications, such as morphine, ondansetron, ceftriaxone, and immunoglobulin G, may also be infused through the subcutaneous route, further reducing trauma for older adults compared with multiple attempts at IV access.[24]

The Sensory System

Vision, hearing, and tactile sensations also alter with aging. Visual acuity decreases, and the need for extra light and/or glasses occurs.[2,4,15] Hearing diminishes as a result of degeneration and atrophy of the structures of the inner ear and loss of sensory hair cells; 40% of adults over the age of 75 have hearing loss.[2,4,15] Tactile sense diminishes as a result of slower conduction and functional changes in the peripheral nerves, resulting in a reduced ability to identify painful sensations or extreme temperatures.[2,5,25] These subtle yet progressive changes occur over time and have an impact on the ability of older adults to receive information accurately about their environment or the activities around them.[25]

When greeting an old-old patient, taking time to speak slowly, clearly, and in a normal tone, while establishing eye contact, is the preferred approach. Touching the shoulder or arm of an older adult is recommended as a mode of communication. A caring touch may improve communication when approaching a person who has diminished vision or hearing.[4] All too often, procedures or nursing care may be initiated before the older adult is completely aware of the activity, creating an unpleasant situation for all concerned. Older adults, like other patients, deserve to be treated with dignity and respect when receiving health care, with specific attention to their individual needs.

Cognitive Ability

The changes that occur in the aging brain that affect mental capacity are unclear. Documented physical changes include an accumulation of lipofuscin, a yellowish pigment in the neurons, which can affect neural function, as well as an alteration in neurotransmitter metabolism, which may decrease neuron function.[25] Thought processes may become slower, and more time may be needed to assimilate information or to respond to questions.[2,4,5] Taking time for an older adult to understand instructions, ask questions, and cooperate with treatments and/or procedures is necessary to accomplish care delivery smoothly and effectively.

Confusion or loss of cognitive function typically is the result of a physical illness or a mental condition, such as Alzheimer's disease or severe depression.[2] When an older adult is confused, delivery of infusion therapy can become challenging. Maintaining vascular access is often a major issue and can lead to increased trauma for the patient. The correct methods for protecting an IV site must be used. Securement devices for all IV catheters, peripheral and/or central, should be used. A flexible mesh tubular dressing can be used to help protect the site from excess manipulation or from the patient "picking" at it. A long-sleeve gown or sweater also can be used to protect the IV site from agitated hand movements of a confused or disoriented older adult.

Avoid wrapping the infusion site with gauze roller bandage or wide tape in an effort to secure a VAD. This approach does not comply with standards of practice, and risks patient injury.[7] If a bandage or tape is too tight, impaired circulatory return can occur below the VAD and could cause tissue damage. In addition, when a vascular access site is completely covered, initial signs and symptoms of complications related to vascular access and infusions can be missed. Extreme infiltrations or the extravasation of vesicant agents can easily lead to severe tissue damage and result in a legal issue.[5,6]

Other mitigations may be possible for difficulties with older adults experiencing cognitive issues. Requesting that a family member stay with a confused older adult has been successful for short-term infusions in some care settings. The use of physical or chemical restraint for a confused older adult is viewed as a last resort, used for a limited period of time, and requires a physician order. Always verify the institution's or organization's policies and procedures before using physical or chemical restraints.

CONCLUSION

Older adults are a special patient population and deserve to receive evidence-based infusion therapy. As we care for older adults, we must be mindful of recommended care practices for this patient population.

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Erratum

Oral Parenteral Antimicrobial Therapy Administration in a Homeless Population: Erratum

The article by Whitney Hernandez et al. in the March/April 2016 issue of *Journal of Infusion Nursing* (pp. 81-85) was mistitled. The correct title should have been "Outpatient Parenteral Antimicrobial Therapy Administration in a Homeless Population."

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DOI: 10.1097/NAN.0000000000000201

