The purpose of this article is to disseminate valuable information on the following key points: 1) provide a diagram to demonstrate the basic anatomy of a vein, 2) identify the common veins used for peripheral IV (PIV) access, 3) list the most common drug pH values, 4) list the osmolarity values for IV fluid, 5) identify vein complications, 6) discuss basic principles of ultrasound technology, and 7) list the steps for PIV access insertion using ultrasound-guided technology. Nurses having this updated knowledge will improve their clinical practice, patient health care outcomes, and patients’ quality of life.

M.B. is a 35-year-old female admitted to the medical floor, on a Friday evening, for an acute exacerbation of sickle cell crisis. She has been hospitalized at least four times a year during the past five years for pain management, blood transfusions, and hydration. M.B. is known to the nursing staff and her primary care providers as a patient with difficult IV access issues. Additionally, she refuses to have either an implanted vascular access port or a Peripherally Inserted Central Catheter (PICC) line inserted.

After two failed attempts during M.B.’s most recent admission, she had a 22-gauge IV catheter placed in a small branch of the median cephalic vein located on her left forearm. However, four hours later, after receiving only two doses of morphine sulfate intravenously, her IV site became red, swollen, tender to the touch, and had to be discontinued. M.B.’s primary care nurse had the charge nurse make one more attempt to restart M.B.’s PIV, without success.

M.B. was crying because her joint and back pain remained at a 10 on the 0-10 pain scale. M.B.’s pain was further compounded from several unsuccessful IV attempts and her pain medication had to be administered by the intramuscular (IM) route. M.B. also complained of pain and a burning sensation at her IM injection sites and stated, “Please just let me die. I cannot take this pain anymore!”

Pain medications, such as morphine sulfate, are known to cause localized inflammation and pain, especially when infused into small diameter veins. IV medications can have either an acid or alkaline base (see Table 1), causing inflammation to surrounding endothelial cells of blood vessels. These cells are fragile and are responsible for the development of the inner layer for healthy blood vessels (Pries & Kuebler, 2006; Sumpio, Riley, & Dardik, 2002).

Figure 1. Anatomy of an Artery and a Vein

Pain medications, such as morphine sulfate, are known to cause localized inflammation and pain, especially when infused into small diameter veins. IV medications can have either an acid or alkaline base (see Table 1), causing inflammation to surrounding endothelial cells of blood vessels. These cells are fragile and are responsible for the development of the inner layer for healthy blood vessels (Pries & Kuebler, 2006; Sumpio, Riley, & Dardik, 2002).

continued on page 10
Sometimes I have a sense of uncertainty and fear when I learn of significant global events. Russia recently invaded Ukraine. Nearly 300 young Nigerian girls were abducted while at school. A Malaysian airplane with hundreds of passengers aboard went missing. Unrest continues in the Middle East. Rebels destroyed parts of Syria, dislocating thousands of people. Threats of terrorism are not uncommon. Ravaging weather events such as record temperatures, droughts, tsunamis, earthquakes, tornadoes, and hurricanes seem to be happening all the time. These occurrences are bigger than what any one person can fix, but they certainly cannot be ignored.

As I was pondering the complexity and seriousness of national and global events, I wondered what nurses could and should do to help. There are about 3 million registered nurses in the United States. We have all been trained and know how to provide care, education, kindness, and compassion, and we have a unique skill set to heal. I would encourage everyone in the nursing profession to know what to do in the event of a disaster. Stay up to date on the disaster-preparedness policies in the area where you live and practice. Talk with your colleagues about what nurses can do collectively to assist in times of crisis and need. Maybe it’s providing hands-on medical care for people injured from violence or natural disasters. Perhaps your group of nurses could educate communities on safety. Maybe you could join with nurses in political arenas to promote needed change. Our colleagues stationed overseas in the Armed Forces appreciate care packages or letters of support from nurses back home. Because there are more individuals in nursing than in any other health care profession, nurses have the most ability to help when people need the care we know how to provide. We can’t do it alone, but we can certainly make a difference if we all work together.

The world can be a scary and rapidly changing place, but this has been the case since the beginning of history. As nurses, we must join together to maintain a sense of peace and calm authority that we know how to help. New skills – like starting IVs through the use of ultrasound and identifying tubing connection errors – should always be added to our repertoire. Enhanced knowledge (such as learning about uncommon disorders like spasmodic dysphonia) needs to be added to our intelligence banks. Networking with other nurses at conferences (such as the annual AMSN Convention) is essential if we are to work as a collective unit in solving some of the world’s problems.

Although global problems can be overwhelming and daunting, nurses need to join together and care for each other so we can all do what we do best – provide care for others.

Molly McClelland, PhD, MSN, RN, CMSRN, ACNS-BC
MedSurg Matters! Editor
reduce the risk of small-bore connector hazards, a group of international organizations (including the FDA, Association for the Advancement of Medical Instrumentation [AAMI], International Standards Organization [ISO], and Centers for Medicare and Medicaid [CMS]) have developed standards that provide general requirements for liquids and gas connectors. They have also created a framework for testing that ensures incompatibility and non-interconnector fit of Luer vascular devices with enteral and other small bore connectors to eliminate misconnections. This standard was published in 2011, and the new enteral connectors reached the market in 2014.

New enteral tube feeding connectors are now available. You may be seeing these changes in your practice setting today. If your unit isn’t using the new, safer connectors, ask your manager or clinical specialist why.

The change in manufacturing is not based on color. Nurses will not be able to assume that all purple connectors are enteral, for example. IV lines and ports may also be purple colored. The change is based upon connector size and compatibility. IV connectors, for example, should no longer Luer lock into any enteral device. The ability to connect IV and enteral devices should no longer be possible.

There are several things medical-surgical nurses can do to assure that safe care is provided during the transition of the connector standards and acquisition of the new and improved products:

1. Develop a risk assessment and action process. Brad Noé, Small-Bore Connector Committee Chair at AAMI, shares the following recommendations to reduce risk and promote a smooth transition (Vockley, 2011):
   - Evaluate workarounds occurring in the clinical setting (workarounds indicate that the clinicians are doing something outside of intended use because what they have to work with is not functioning).
   - Eliminate adaptors (these are a signal that workarounds or modifying clinical practice to accomplish a task is an acceptable practice).
   - Conduct safety audits (look at your practice within the safety guidelines).
   - Create cross-functional clinical practice teams so that all stakeholders can have a role in decision-making process to ensure continuity of action across the supply chain and pipeline (for example, pharmacy should prepare oral medication in the oral syringe for administration).
   - View reporting of misconnections or near misses as instructive and informational – versus reacting in a punitive or threatening way.

Although under standard and product design revision, enteral misconnections remain a hazard to patient safety in health care settings. We have an obligation to our patients to assure safe care. We must ensure that hospital leaders are aware of this potential risk and work with purchasing departments to encourage and demand alternate solutions for
Spasmodic Dysphonia

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Objectives
The purpose of this continuing nursing education article is to increase nurses’ and other health care professionals’ awareness of spasmodic dysphonia. After studying the information presented in this article, you will be able to:
1. Explain spasmodic dysphonia and its symptoms.
2. Discuss the process of diagnosing spasmodic dysphonia.
3. Describe treatments available to patients with spasmodic dysphonia.
4. Identify resources available to those affected by spasmodic dysphonia.

Note: The author, editor, editorial board, and education director reported no actual or potential conflict of interest in relation to this continuing nursing education article.

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Spasmodic dysphonia (SD) is a rare, neurogenic voice disorder that is often undiagnosed or misdiagnosed due to its similarity to other voice disorders and a lack of research data. SD affects approximately 1 in 10,000 adults in the United States (Revelo, Underbrink, & Quinn, 2009). The objective of this article is to enable readers to gain a general understanding of SD, the diagnostic process, treatments, and resources available to those affected by this disorder.

Speech is produced when air from the lungs is pushed between the vocal cords, causing them to vibrate (Luc & Zieve, 2012). Spasmodic dysphonia (SD) is a voice disorder characterized by involuntary movements or spasms that prevent the normal vibrations of the vocal cords and the production of a normal voice (see Figure 1). It is also referred to as laryngeal dystonia, which is a form of focal dystonia (National Institutes of Health [NIH], 2010a).

Dystonia is defined as involuntary muscle contractions that cause repeated movements generating tremors, twitches, or abnormal postures (National Institute of Neurological Disorders and Stroke [NINDS], 2011). Dystonias are classified according to the part of the body affected with generalized dystonia affecting most parts of the body.

- Focal dystonia is localized to one part of the body, such as the intrinsic laryngeal muscles in SD (Revelo et al., 2009).
- Multifocal dystonia occurs when two or more unrelated areas of the body are affected.
- Segmental dystonia involves two or more adjacent parts of the body.
- Hemidystonia affects the arm and leg on the same side of the body (NINDS, 2011).

Types of Spasmodic Dysphonia

There are three types of spasmodic dysphonia. In adductor spasmodic dysphonia, the vocal folds close together and stiffen with spasms, making vibration of the cords difficult. Patients with this condition find it difficult to start talking and words are often cut off with the spasms. In abductor spasmodic dysphonia, the vocal folds do not close properly due to muscle spasms that prevent the folds from vibrating to produce voice. In this situation, the voice will sound weak and breathy due to air escaping from the lungs during speech. In adductor and abductor spasmodic dysphonia conditions, the voice sounds normal while singing, shouting, laughing, and crying (NIH, 2010a). Mixed spasmodic dysphonia, which is rare, is characterized by spasms of the different muscles that open and close the vocal folds. As the name suggests, it has the characteristics of both adductor and abductor spasmodic dysphonia (NIH, 2010a).

The most common form of spasmodic dysphonia is the adductor type. The symptoms for adductor SD include a choked, strained voice with sudden breaks in speech in the middle of vowels. In the less common abductor type SD, the voice sounds breathy with whisper quality voice breaks. In mixed type SD, both types of symptoms are present (Revelo et al., 2009).

Causes

There are no known causes for spasmodic dysphonia because no long-term research data is available. SD was originally thought to be psychogenic in nature due to lack of readily available research information. However, current studies indicate that SD is a neurogenic voice disorder (Luc & Zieve, 2012). Some clinicians and genetic researchers believe SD may be hereditary because...
**Table 1. Methods Used to Diagnose Spasmodic Dysphonia**

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electromyography</td>
<td>It is the recording of electrical activity of muscle with the use of an electromyograph machine to diagnose muscle and nerve disorders.</td>
</tr>
<tr>
<td>Fiber optic laryngoscopy</td>
<td>A procedure done with a flexible lighted scope which is passed through the mouth or nose to view the larynx, vocal cords, and do biopsies if needed.</td>
</tr>
<tr>
<td>Phonatory aerodynamic test</td>
<td>This is a test done to check the air pressure and vibration during speech with the person speaking into a facial mask and tubing attached to machine. The test measures maximum phonation time, mean air flow rate, subglottic pressure, glottal efficiency, glottal resistance, and vital capacity.</td>
</tr>
<tr>
<td>Videostroboscopy</td>
<td>This is a procedure done with a scope, camera, recording device and a strobe light to record slow motion images of the vocal cords at rest, as well as speech. A strobe light emits synchronized flashes of light to the moving vocal cords at a slower speed to create the image.</td>
</tr>
<tr>
<td>Vocal Spectrography</td>
<td>This is a recording or picture of sound waves during speech.</td>
</tr>
</tbody>
</table>

Source: Adapted from Yeson Voice Center & Yeson Artceum, 2011.

members of the same family often suffer from this disorder (NIH, 2010a). Scientists and clinicians at the NIH facilities (as well as other medical centers), NINDS, and the National Institute on Deafness and Other Communication Disorders (NIDCD) are performing genetic research to identify causes of focal dystonias. These researchers believe that brainstem and basal ganglia lesions are contributing factors in such movement disorders. Patients with SD may also have spasms of other parts of the body such as the neck, jaw, arms and legs, eyelids, lips, or tongue (NIH, 2010a). The National Eye Institute (NEI) supports the study on Blepharospasm and other eye movement disorders, and the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) supports research on dystonias and rehabilitation for such disorders (NINDS, 2011).

**Diagnosis**

Spasmodic dysphonia is often undiagnosed in its early stages, because the symptoms are similar to other voice disorders. A detailed history must be obtained by an otolaryngologist who is specially trained in voice disorders, with special emphasis on the onset and progression of the voice dysfunction. Deterioration of voice quality under stress and during telephone conversation is a typical feature of SD. Voice improvement is noted temporarily after the consumption of alcohol and sedatives (Revelo et al., 2009). Other conditions that may affect the voice such as amyotrophic lateral sclerosis (ALS), Wilson’s, Huntington’s, and Parkinson’s diseases should be initially ruled out using past and present medical history, diagnostic tests, and referrals to other specialists (Revelo et al., 2009).

An otolaryngologist can diagnose SD as well as eliminate other speech pathologies such as voice tremors and vocal cord paralysis. The evaluation involves passing a flexible laryngoscope through the nose to the back of the throat to observe the movements of the vocal folds during phonation and cough. Electromyography, fiber optic laryngoscopy, videostroboscopy, aerodynamic testing, and vocal spectrographic analysis (see Table1) are other methods that aid in the diagnosis (Revelo et al., 2009).

**Treatment**

No long-term research data is available for a definitive cure for spasmodic dysphonia. Symptomatic treatment to the larynx is the current treatment approach for SD. Speech therapy may be advised initially for mild symptoms of SD; however, if no improvement occurs after 8-10 therapy sessions, Botulinum Toxin A (Botox®) therapy is second line of treatment (Pitman, Kumat, Bliznikas, & Baredes, 2011).

Injections of very small amounts of Botox to the affected, hyperfunctional laryngeal muscles weaken them by blocking the nerve impulses (chemical denervation). The weakened muscles reduce spasms and improve voice quality for a few months (Revelo et al., 2009). Laryngeal electromyography is utilized to identify the muscles for the injection of the Botox. The voice may become breathy, and swallowing may be difficult for a few days after injection due to muscle weakening. The injections are repeated every 3-8 months per individual requirements for the maintenance of a normal voice (Revelo et al., 2009).

Clinicians and researchers are currently studying several surgical treatments; however, the results are conflicting. The types of possible surgeries include:

- **Type 2 thyroplasty** – This procedure changes the shape of the thyroid cartilage to relax and lateralize the vocal folds slightly to enable easier phonation (Ishiki, Yamamoto, & Fukagai, 2004). As of 2009, there were no long-term studies for this procedure according to Revelo and co-authors (2009).

- **Recurrent laryngeal denervation and reinnervation** – First attempted in 1999 by Dr. Gerald Berke at the University of California in Los Angeles, this intervention involves the resection and reanastomosis of bilateral adductor branches of the laryngeal nerve to the ansa cervicalis (Pitman et al., 2011).

- **Bilateral transarytenoid and lateral cricoarytenoid myectomy** – This surgery is usually performed one side at a time, at least six months apart. The myectomy weakens the vocal folds and prevents spasms (Pitman et al., 2011).
These surgical treatments need to be researched further and evaluated for long-term effects.

Husain and Shakeel (2010) conducted a study in Scotland on selective lateral laser thyroarytenoid myotomy for adductor spasmodic dysphonia. Two women and two men who had been managed with Botox therapy for adductor spasmodic dysphonia for an average of 11 years underwent laser surgery. All four patients had improved voice quality and fluency and required no further Botox injections. At the time of publishing of the study, the subjects had been followed for 2.5 years. The weaknesses of the study are the small sample size and the short amount of time the subjects were studied. However, the results reveal promising innovations for SD management.

Prior to diagnosis and treatment, M.T.'s voice problems were so severe that she was afraid to speak. M.T. spoke with great effort in a strained voice and took frequent pauses to take deep breaths. No abnormal facial movements, ear, or nose problems were noted on initial examination. A fiber optic nasal endoscopy of her larynx revealed evidence of premature spasms with symmetric vocal cord movement. Her history and findings were consistent with adductor spasmodic dysphonia.

Treatment was initiated at the Grabscheid Voice Center in New York by an otolaryngologist who specializes in voice disorders. Her condition was treated with 2.5 units (0.1 mL) of Botox injections to the thyroarytenoid muscles (see Figure 2) using a transcricoid approach under electromyography guidance. Because this was M.T.'s first treatment, the otolaryngologist decided to inject only the right side to observe her response to the Botox. After one week of a breathy, weak voice, she began to speak without pausing.

After three months, M.T. returned to the Voice Center for a repeat injection because her speech was getting worse with spasms, and she had an increasing need to pause during conversation. At this appointment, she had both sides injected with 1.75 units of Botox, into the cricoarytenoid muscles, and she began speaking in a normal voice (which lasted about six months) after a breathy period of about three weeks. The next treatment was with 1.5 units of Botox (less than the previous dose) injection on each side. The breathy, weak voice lasted about two weeks, and she maintained her normal voice for almost ten months. M.T. returned for treatments whenever her voice problem would become evident again. The longest interval of normal voice for M.T. was close to 19 months, after a unilateral (right side) injection of 2.0 units Botox.

Currently, M.T. continues to receive Botox injections to her vocal folds every 9-12 months. Her voice has returned to baseline, but she does notice a gradual return of symptoms as the injections wear off. M.T. states that

**Figure 1. Structures Involved in Speech and Voice Production**

the quality of her life has improved, as she is no longer afraid to speak.

**Psychological Support**

People with spasmodic dysphonia may become anxious and introverted and avoid speaking in public to avoid embarrassment. They may encounter ridicule from those around them, and the stress and fear they experience may increase tension in the muscles, causing vocal cord spasms. Career advancement, as in the case of singers and public speakers, may be halted because voice use is a necessity in these vocations (NIH, 2010b). Quality of life may be affected because they are reluctant to speak and/or socialize.

Patients affected by voice disorders need understanding and support. Empathetic health care providers can decrease their anxiety and stress, thus decreasing tension of the laryngeal muscles (NIH, 2010b).

The National Spasmodic Dysphonia Association (NSDA) website (http://www.dysphonia.org) has an online Bulletin Board with an interactive forum for people with SD, a video gallery with information on SD for review, and an online store. The online store offers free brochures on SD and books and videos for purchase. There are support groups, literature, and educational seminars which may be sourced from the website (NSDA, 2013). If there is no support group available in an area, one may be formed with the help of the NSDA.

**Conclusion**

Spasmodic dysphonia is a focal dystonia involving the laryngeal muscles and vocal cords. The current treatment of choice is Botulinum Toxin injections into the laryngeal muscles. More permanent, surgical treatments are still under research and review. The current treatments for SD are symptomatic. If the quest to find the underlying cause is successful, a cure for the disease may become an easier task for researchers.

**References**


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Legal Issues and Disaster Preparedness: Are You Ready For a Community Disaster?

Part Two

This article provides information about some of the legal issues health care providers may encounter during a disaster. Part one of this article (published in the January/February issue) explains relevant resources on federal, state, and local levels (Neil, 2014). Part two explains the importance of preparation, training, and exercises to maintain legal standards.

In part one of this series, we discussed the federal, state, and local authorities that regulate the planning efforts associated with disasters. The Centers for Disease Control and Prevention (CDC, 2009) developed six categories of specific hazards:

2. Bioterrorism – The deliberate release of viruses, bacteria, or other agents to cause illness or death in people, animals, or plants.
3. Chemical Emergencies – The release of a hazardous chemicals that has the potential for harming people’s health.
4. Recent Outbreaks and Incidents – Public health emergencies (for example the outbreak of cyclosporiasis in the U.S. in June 2013).
6. Radiation Emergencies – Nuclear event, dirty bomb, etc.

This article will address the Emergency Management Law associated with health care facilities and their employees.

Health care facilities face many decisions in connection with emergency management activities and associated legal issues. Unfortunately, the nature of disasters is that something has gone wrong or is about to go wrong. Whether the event is the result of an occurrence or imminent occurrence, the threats of severe damage, injury, or loss of life/property are real and force health care facilities and their employees to make very difficult decisions.

Prior to Hurricane Katrina, many hospitals in the New Orleans area would allow patients’ family members, as well as employees and pets, to “wait out the storm” in their facilities. The aftermath of Katrina proved this to be a poor decision that produced very negative results. Not only were these hospitals responsible for housing, feeding, and protecting their patients and staff, but now they had an unknown number of hungry, hot, tired, and frightened guests to care for as well. The extra number of survivors extremely taxed the insufficient numbers of supplies, equipment, and the facilities. Post Katrina, guests of any type are no longer allowed to remain in hospitals when an emergency is declared.

Employees are placed into “Storm Categories” every year prior to hurricane season. The basic three classifications of employees (according to availability) are:

- The Exempt Employee – These employees have legitimate reasons for not being available during a storm (e.g., pregnancy, health condition, spouse has to report to duty [military or health care], care of an elderly parent, ventilator dependent child, etc.).
- The Activation Team – These employees are willing and able to report to the facility upon Disaster Activation and remain for at least 72 hours post event. This requires a great deal of preparation and sacrifice. These employees must be self-sufficient and resourceful, and be able to handle stressful situations and the possibility of extreme temperature conditions.
- The Recovery Team – These employees are sent to a designated safe area to “wait out the storm” and return 72 hours after the event to relieve the Activation Team. These individuals must also be extremely prepared and able to handle stressful situations. Recovery Team members will require credentials from community law officials for admission into the parish, city, and facility. Some facilities house and transport their Recovery Team after the first 72 hours. Upon dropping off the Recovery Team, they transport the Activation Team to the designated safe area.

Legal Issues and Disasters

The legal challenge for leaders of health care facilities for emergency management as a whole lies in taking proactive steps to avoid bad choices like the ones experienced in New Orleans before, during, and after Katrina. Of course, not every bad choice can be prevented. However, with careful planning in all phases of emergency management, the outcomes of a bad situation may be vastly improved. During development of the Emergency/Disaster Management Plan, legal counsel should be sought to maintain what is known as “litigation mitigation” (Nicholson, 2003).

Litigation mitigation has three goals:
1. Reduced exposure to legal claims.
2. Improved life safety.
3. Enhanced property protection.

Many other laws affect emergency management’s daily activities. Some of these laws spring from duties specific to the discipline, such as obligations to plan, train, and exercise. Nursing unit managers have obligations that arise from their positions, like complying with facility policy and procedures, governmental regulations, and legal and ethical issues. Negligence is a common law doctrine that states: every per-
son has a general obligation to act in a reasonable manner at all times, considering the circumstances. When one acts unreasonably (or fails to act), and that act (or failure to act) is the legal cause of an injury to a person or property, liability ensues (Nicholson, 2003).

In emergency management, negligence (see Table 1) usually arises from:

1. Failure to prepare.
2. Failure to protect.
3. Failure to train or educate staff.
4. Failure to provide safe and available operational resources.
5. Patient abandonment (i.e., Breach of Duty).
6. Failure to comply with legal duty (i.e., OSHA violations).

All health care facilities face the potential of dealing with employees who act in ways that are contrary to the requirements of the best interests of the organization. Personnel issues often consume a large percentage of the unit manager’s time. While employment law is a subject with many potential intricacies, understanding the basics will be of great benefit to the unit manager. Knowing the fundamental outlines of this area of law will assist in planning ahead to avoid personnel disputes, an important aspect of litigation mitigation. This knowledge will also provide insight into the best way to react when problems, such as disasters, do occur. Ideally, both the employer and employee should understand that it is to their mutual benefit to cooperate in helping the facility successfully survive during a disaster.

Health care providers must comply with a wide variety of legal responsibilities that spring from federal and state statutes, local ordinances, case law, and policies. Some of these apply specifically to emergency management, having been drafted specifically for nursing. Avoidance of liability requires creating a proactive partnership with legal advisors that runs through all phases of emergency management. In mitigation for example, updating fire and building codes to address local hazards can mean a less severe effect from a disaster. Before a disaster strikes, an individual with legal expertise and a human resources representative can help draft plans, evaluate training standards, and monitor exercises for potential legal issues, as well as assure that emergency operating procedures revisions are legally sufficient. During emergency response, the legal expert may advise the leader of the unit and the emergency management team regarding the potential legal aspects of various response options. During disaster recovery, the legal expert/human resource representative can help to make sure that expenses are properly documented and that the transition into mitigation is properly performed. Only when health care providers and the legal experts who advise them understand each other's responsibilities and contributions can they work together to diminish the potential for litigation.

Conclusion

As a Certified Legal Nurse Consultant, I believe it is very important to take all steps to avoid the potential for litigation. As a nurse manager of a medical-surgical unit for 22 years and a nurse for 28 years, I know that all actions taken to avoid loss of life are critical to all emergency management plans. Med-surg nurses and certified legal nurse consultants have proven to be effective, useful members of the health care team during disasters, saving lives and avoiding unnecessary litigation.

References


Helen P. Neil, MSN, RN, CLNC, is President and Owner, Neil Nurse Consulting, LLC, New Orleans, LA. She is the “Legal Nursing” Column Editor.
A phone call was made to M.B.’s physician to report the multiple unsuccessful IV access attempts, consequent poor pain management, and an inability to infuse IV therapy to correct dehydration. M.B.’s nurse requested an order for peripheral intravenous (PIV) access insertion per ultrasound-guided technique by a skilled infusion nurse. M.B.’s nurse and other nurses working in the hospital that evening were not educated or skilled to use the ultrasound-guided technique. When M.B.’s nurse called the infusion team’s phone number, a recorded message stated, “Services are available Monday through Friday during the hours of 7 a.m. through 5 p.m.” M.B.’s nurse had to place another call to M.B.’s physician to report that a vascular access nurse was not available until Monday morning and requested M.B.’s physician to consider ordering an implanted vascular access port or a central line, because M.B. had finally consented for either procedure to be performed.

Does this patient’s experience sound familiar?

Overview

Patients seen in an emergency department (ED) setting or admitted to the hospital will more than likely require PIV access to obtain lab work, receive IV fluids and medications, or to aid the transfusion of blood products (Blaivas, 2005; Chinnock, Thornton, & Hendey, 2007). The ability to establish a PIV access is a technical skill for nurses and other health care providers to master. While PIV insertion is considered a basic technical skill for nurses, it still requires nurses to have formal didactic education along with clinical experience.

PIV catheter insertion is considered the second most invasive procedure for patients seeking medical care in a hospital or outpatient care setting (Trim, 2005). PIV insertion can pose challenges to nurses caring for patients without visible or palpable veins and contribute to delays in patient care (Aponte, Acosta, Rigamonti, Silvia, & Austin, 2007; Trim, 2005).

A serious problem arises when nurses lack the appropriate vein assessment and technical skills required to establish PIV access for patients with no visible or palpable veins (Aponte et al., 2007). The most common contributing factors leading to failed PIV access include no visible or palpable peripheral veins, obesity, chronic illnesses that require frequent PIV insertions resulting in limiting future IV sites, IV drug abuse, dehydration, steroid use, peripheral edema, and/or health care professionals lacking the necessary technical skills (Aponte et al., 2007; Blaivas, 2005; Costantino, Kirtz, & Satz, 2010; Trim, 2005).

A recent national hospital ambulatory medical care survey identified that the number of ED visits increased from 90 million to 114 million annually (McCaig & Burt, 2003). It is apparent that gaining PIV access promptly is of great importance for improving patient health care outcomes and time management. Therefore, a serious need exists for nurses to be educated on how to use ultrasound technology when caring for patients who are known or identified as difficult PIV sticks.

Justification for Using Ultrasound Guidance For PIV Access

When nurses are unable to obtain an appropriate PIV site, serious problems can occur such as a delay in making a medical diagnosis; administration of IV fluids, medications, and blood products; and vascular complications. These delays and vascular complications can place health care professionals and health care organizations at risk for litigation issues (Arbique & Arbique, 2007; Chinnock et al., 2007; Infusion Nurses Society [INS], 2011; Trim, 2005). Other concerns include the extra time required for multiple nurses to attempt access of a peripheral vein leading to increased non-productive nursing time, added costs from wasted medical supplies, and the unnecessary pain and suffering experienced by patients (INS, 2011; Trim, 2005).

While most nurses may have some basic education on how to establish PIV access, some may still lack the technical skill required to achieve successful PIV access for any patient. Therefore, the authors believe that PIV insertion success will be best achieved when nurses: a) have an awareness about the anatomy of veins and fragile endothelial cells (see Figure 2).
b) know the names and locations of the best peripheral veins recommended for PIV access (see Figure 2), c) know how to perform an accurate vein assessment prior to attempting PIV access, d) are proactive to question why a PIV is needed, and e) know the complications of vein injury caused by administration of IV medications and IV fluids.

There are several advantages for nurses to understand these key points. When nurses master either the basic or advanced skills required to insert a PIV successfully, this knowledge will help reduce unnecessary pain inflicted from multiple failed attempts, delays in medical care, waste of expensive medical supplies, non-productive nursing time, and improve nursing practice (Hadaway & Millam, 2005; INS, 2011).

The authors also recommend that nurses review the importance of how the pH levels of IV medications (see Table 1) and the osmolality characteristics for IV fluids (see Table 2) can contribute to vascular complications. Nurses must know to avoid using small diameter veins when administering IV medications and/or IV fluids as this causes damage to the inner layer of a vein’s endothelial cells, leading to the inflammation process and eliciting painful IV sites and infiltration (Chernecky, Macklin, & Murphy-Ende, 2005; Macklin & Chernecky, 2004).

Nurses must also understand that using large diameter peripheral veins to administer IV medication or IV fluids is always the best procedure because it reduces the risk for endothelial cell damage due to rapid blood flow and will also help prevent the need for higher risk procedures like a PICC line or an implanted vascular access port. Rapid blood flow has diluting effects for low pH (acidic base) or high pH (alkaline base) fluids and medications. Nurses must also be aware that vein damage to surrounding endothelial cells can occur when an IV catheter is not properly secured or is placed in an active joint that is not immobilized (INS, 2011).

When nurses receive initial education on how to perform an accurate vein assessment, patients can be promptly identified as difficult sticks so the ultrasound technique can be used instead of ongoing blind sticks. The use of ultrasound technology becomes a win-win situation in reducing delays in medical care and supply costs, improving patient health care outcomes and satisfaction and improving nursing practice.

The Best Peripheral Veins to Access

The best superficial veins for PIV access or venipuncture access are referred to as the antecubital veins (see Figure 2). The median cubital vein is the first choice because it has a large diameter, is well anchored to surrounding tissue, easy to access, and the least painful site for the patient (McCall & Tankersley, 2008). The cephalic vein is the second choice; while it is often more difficult to palpate, it is well anchored by its surrounding tissue. The basilic vein is the third choice because it is easy to palpate; however, it is not well anchored and can be a painful site to access. Nurses must use extreme caution when using the basilic vein because it lies close to the brachial artery and two nerve branches (Arbique & Arbique, 2007; McCall & Tankersley, 2008). While these sites are recommended to access first, the major disadvantage for access-
Figure 5. 
Vein Cannulation and Observable “Star” Shape

Ultrasound Basics

Ultrasound technique for PIV access is not a new concept and is being utilized more frequently across the nation by nurses in cases where peripheral IV access is difficult or impossible (Aponte et al., 2007; Gregg, Murthi, Sisley, Stein, & Scalea, 2010). The first use of ultrasound imaging can be traced back to the 1930s (Hadaway & Millam, 2005; Macklin & Chernecky, 2004). The use of ultrasound for PIV access is safe, rapid, effective, improves patient outcomes, and increases patient satisfaction (Costantino et al., 2010).

Ultrasoundography is a non-invasive procedure that uses high frequency ultrasound waves (7.5-15 MHz) produced by a transducer to create real-time images of organs, tissues, and blood flow (Rumack, 2005). The imaging device contains two basic components: a transducer and a display screen. There are several types of ultrasound transducers available. The linear transducer is recommended for PIV access when attempting to isolate structures located 1-3 cm beneath the skin (Rumack, 2005).

Real-time images produced by the transducer offer nurses a visual advantage for locating the best peripheral
veins to access. This approach provides direct measurement of blood vessel diameter and condition. Ultrasound technology also allows the visualization of the IV catheter tip inside the vein, increasing the chance for prompt and successful venous access. This helps nurses determine the most appropriate PIV site and appropriate catheter size, and to verify placement of the IV catheter.

**Table 1. pH Values of Common Medications**

<table>
<thead>
<tr>
<th>Medication</th>
<th>pH</th>
<th>Acid</th>
<th>Neutral</th>
<th>Alkaline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meperidine (Demerol)</td>
<td>3.5-6</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morphine</td>
<td>2.5-7</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydromorphone (Dilaudid)</td>
<td>4-5.5</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fentanyl</td>
<td>4-7.5</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Promethazine (Phenergan)</td>
<td>4-5.5</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ondansetron (Zofran)</td>
<td>3-4</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prochlorperazine (Compazine)</td>
<td>4-6.2</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lorazepam (Ativan)</td>
<td>0</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diazepam (Vialum)</td>
<td>6.2-6.9</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haloperidol (Haldol)</td>
<td>3.3-6</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midazolam (Versed)</td>
<td>3.0</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diphenhydramine (Benadryl)</td>
<td>5-6</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydralazine (Apresoline)</td>
<td>3.4-4</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propanolol (Inderal)</td>
<td>2.8-3.5</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verapamil (Isotin)</td>
<td>4-6</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atenolol (Tenormin)</td>
<td>5.5-6.5</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrocortisone (Solu-Cortef)</td>
<td>7-8</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>2.4-4.5</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tobramycin</td>
<td>3-6.5</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gentamycin</td>
<td>3-5.5</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefazolin (Ancef)</td>
<td>4.5-7</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular Insulin</td>
<td>7-7.8</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Dextrose</td>
<td>3.5-6.5</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heparin</td>
<td>5-8</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Magnesium Sulfate</td>
<td>5.5-7</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furosemide (Lasix)</td>
<td>8-9.3</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naloxone (Narcan)</td>
<td>3-4</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dexamethasone (Decadron)</td>
<td>7-8.5</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Potassium Chloride</td>
<td>4-8</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Famotidine (Pepcid)</td>
<td>5-5.6</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal Saline Flush</td>
<td>4.5-7</td>
<td>√</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2. Osmolality of Intravenous Fluids**

Osmol is the standard unit of osmotic pressure in the blood. It is the weight in grams of a solute existing in a solution as molecules. Osmolality is the number of milliosmols (mMol/L) per kilogram of solute. Osmolality is the number of milliosmols per liter of solution. Tonicity of IV solutions will be stated as mMol/L.

**Hypotonic** (Osmolality < 250 mMol/L) fluid lowers osmotic pressure causing fluid to invade the endothelial cells in the inner lining of the vein. Depending on the degree of hypotonicity, the volume being pulled into the cell may cause cells to swell and burst. Hypotonic fluid may be used to treat electrolyte imbalances.

**Isotonic** (Osmolality 250-350 mMol/L) fluid will not initiate movement of fluid from or into the blood cells, is less likely to damage endothelial cells in the inner lining of the veins and arteries and rapidly expands intravascular volume. These IV fluids are the best choice to reduce vascular complications when using small peripheral veins. One indication for the use of isotonic solution would be in the event of hypotension secondary to hypovolemia (Labus, Wang, & Terry, 2010).

**Hypertonic** (Osmolality 350 mMol/L and above) fluid moves into the vascular system and out of the blood cells. Water moves from the cells of the endothelial layer of the vein wall into the infuscate in the circulating blood resulting in shrinkage and dehydration of the endothelial cells of the tunica intima layer. This process results in phlebitis, infiltration, extravasation, sclerosis, and elicits pain (Alexander & Corrigan, 2004; Perdue & Duggar, 2004). After surgery, hypertonic solutions may be used in the event of the stabilizing of blood pressure, normalizing of urine output, and lessening the risk of edema (Labus, Wang, & Terry, 2010).

<table>
<thead>
<tr>
<th>IV solution</th>
<th>Hypotonic</th>
<th>Isotonic</th>
<th>Hypertonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Chloride Solutions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.45% NS</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.9% NS</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0% NS</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0% NS</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dextrose Solutions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D 5W</td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>D 10W</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentrations of 20, 40, 50, 60, 70%</td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Dextrose/Saline Solutions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D5 0.225% NS</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D5 0.33% NS</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D5 0.45% NS</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D 2.5% 0.45% NS</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>D 10% 0.225% NS</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>D 10% 0.45% NS</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>D 10% 0.9% NS</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Electrolyte Solutions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ringers Lactate</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D 5% RL</td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Lactated Ringers injection (Hartmann’s Solution)</td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Other electrolyte solutions are mostly isotonic until Dextrose is added. Then the solutions become hypertonic</td>
<td></td>
<td></td>
<td>√</td>
</tr>
</tbody>
</table>

**BLOOD PRODUCTS**

Blood | √ |
Plasma | √ |
Ultrasound technique locates the best blood vessels to access on extremities and will show the structural differences between arteries, veins, and nerve bundles. This will aid in identifying the condition of the blood vessel, preventing or reducing failure rates and vascular complications (Rumack, 2005).

References

Basic Steps for Ultrasound-Guided Peripheral IV Access

1. Check for physician's order for PIV. Using ultrasound-guided technique to assess veins is an extension of the nursing assessment process.
3. If local anesthetic is to be used, follow your facility's policy. A typical dose is: lidocaine 1% (without epinephrine) 0.1-0.2 cc intradermal.
4. Review your site for contraindications/arm restrictions such as: infection, mastectomy, hemodialysis access site.
5. Gather supplies: PIV materials, 3 ml 2% chlorhexidine applicator, 2 towels, 1 washcloth, ultrasound device, sterile and non-sterile ultrasound gel, a sterile occlusive dressing to cover the transducer, and if local anesthetic is to be used, a tuberculin or insulin syringe for the anesthetic.
6. Introduce yourself and set up equipment/supplies.
7. Wash your hands.
8. Raise the bed, and recline the patient with an arm extended perpendicular over a bedside table.
9. Adjust the ultrasound machine's screen depth to about 2 cm.
10. Apply the tourniquet and the non-sterile ultrasound gel. Assess blood vessels looking for the 5 Ss:
   a. Shape – The appropriate shape is round, not flat.
   b. Soft – There should not be any clots, pulsations, or sclerosing.
   c. Size – Larger veins are easier to cannulate and are the best choice.
   d. Straight – No kinks or curves.
   e. Shallow – The closer to the skin surface, the less pain the patient will experience, the easier to cannulate and thread an IV catheter. The preference is a vein that is less than 2 cm deep.
11. Select the optimal PIV site. Remove the tourniquet. Clean off the gel with a washcloth (Figure 1 & 2).
12. Select the appropriate catheter gauge and length. Consider appropriate insertion angle. Open the supplies.
13. Clean the site with 2% chlorhexidine applicator or alcohol.
14. Reapply the tourniquet and don non-sterile gloves.
15. Cover the transducer with a sterile occlusive dressing. Place a small amount of sterile gel near the planned PIV site. Place the transducer on the arm and relocate the chosen vein. If using lidocaine, inject slightly above the vein intradermally, taking caution not to penetrate the vein wall.
16. Insert the catheter at an appropriate angle, about 1 cm away from the center of the transducer (see Figure 3).
17. Observe the ultrasound screen for the needle tip entering the imaged vein (see Figure 4). Slowly slide the transducer up from the chosen PIV site following the needle tip as it moves toward the vein. You may also view a longitudinal image of the vein, if desired.
18. Watch for the needle tip as you cannulate the vein (see Figure 5). If the IV tip misses the vein, move the needle tip back and adjust the angle of your needle. If unable to see the needle tip, relocate the transducer (consider the transducer angle and position, the angle of the needle, insertion depth, and vein depth). You can gently jiggle the needle tip to observe tissue movement while searching for the needle tip location and position.
19. Move the needle tip into the center of a vein. Stop when you see a shiny “star” shape within the middle of a vein with a blood flashback (see Figure 5). Lower the angle of the needle nearer to the surface of the IV site; while keeping the needle tip in the center of the vein, advance the needle tip about 2-3 mm into the vein. This ensures that the plastic catheter tip is fully inside the vein. Follow the needle tip while advancing or sliding the transducer slightly up from the IV site. Note: If the needle tip is not observed in the middle of a vein during advancement, the catheter may not advance properly and may kink.
20. Thread the catheter of the needle into the vein. Good blood flow should be achieved after removing the needle.
21. Clean-up the IV site and apply a dressing. Procedure is now completed. Remove gloves, wash your hands, and document according to your facility's policy.

Subsumed from literature review and current UT Southwestern Medical Center policy and procedure guidelines.
2009.02.004

Ultrasound-guided peripheral intravenous access in the intensive care unit. Journal of Critical Care, 25(3), 514-519.


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Nutrition to Improve Outcomes

continued from page 3

product connectors. Until this manufacturing change is completely implemented, nurses MUST put safety steps in place. GEDSA, the Global Enteral Device Supplier Association, offers an informational program called “Stay Connected” to facilitate the transition to safer medical connectors. For more information, go to www.gesda.org.

References

Pugliese, G. (2013). New standards to prevent tubing misconnections will have unprecedented impact on supply chain and patient safety.

Suggested Readings


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Grab Your Sunglasses and Join us in Orlando

Have you ever wished for better nutrition for your patients? Do you wonder how nursing’s future will affect you? Are you longing to have a voice in health care change?

You will have the opportunity to get answers to these questions — and many more — this fall at the 23rd Annual AMSN Convention, September 11-14, in Orlando, FL. There will be a wide variety of sessions on medical-surgical nursing’s hottest topics, from hands-on practice updates to pharmacology to leadership. You will take home information that is both innovative and practical that you can put to use immediately at your facility.

Attending on-site has many benefits, like networking, special events, and a dynamic exhibit hall. However, for those of you who can’t make it in person, AMSN will again be offering live video broadcasts of selected sessions. As with all the courses, those will be taught by the country’s leading nursing experts.

Several highlights are described for you below. After you read, visit www.amsn.org to dig deeper into your course options, continue your education information, things to do in Orlando, and more. Be sure to register early to save your spot and take advantage of early bird discounts.

The convention officially launches on Thursday, September 11, with opening ceremonies and the first address, “Do It Well. Make It Fun. The Key to Success in Medical-Surgical Nursing,” by author and humorist Ron Culberson, MSW, CSP. Culberson will teach you how to infuse a little lightness into your day to increase productivity and enhance your work environment.

Michael Bleich, PhD, RN, FAAN, FNAP, an expert in the future of nursing practice and policy, will deliver the convention keynote address, “The Lion and the Lamb: A Nursing Approach to the Affordable Care Act (ACA).” Bleich will explore the roles nurses have played in leading change and advancing health care, as well as shed understanding on the ACA.

One of the convention’s most popular offerings is the interactive Town Hall, which will be held on Sunday, September 14. The topic, “Integrating Nutritional Care to Optimize Patient Outcomes: Med-Surg Nurses at the Forefront,” focuses on one of the most urgent issues today for nurses and health care providers: better patient nutrition.

Several programs are designed to help nurses manage their patients’ nutrition. Three of these programs are described below.

Several programs are designed to help nurses manage their patients’ nutrition. Three of these programs are described below.

**Nutritional Care in the ICU:**
For those who see a majority of their patients in the ICU, this program will provide strategies to help patients achieve a better outcome with nutritional care.

**Nutritional Care in the Critical Care Setting:**
This program will provide strategies for nurses to use as they develop a nutritional care plan for patients in the critical care setting.

**Nutritional Care in the Community:**
This program will provide strategies for nurses to use as they develop a nutritional care plan for patients in the community setting.

Have you ever wished for better nutrition for your patients? Do you wonder how nursing’s future will affect you? Are you longing to have a voice in health care change?