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Techniques in Vascular and Interventional Radiology

Simulation-Based Training of the Nurse Practitioner in Interventional Radiology

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Advanced practice registered nurses, such as Nurse Practitioners (NPs), can be found working in a variety of settings. Niche practices, such as Interventional Radiology, are highly specialized areas and are often specialties in which few NPs get to orient through during their graduate nursing program clinical rotations. For the NP transitioning into an Interventional Radiology practice, formal on-the-job orientation and training can assist in gaining specialty-based knowledge and competencies in performing interventional procedures. Simulation-based training of the NP helps with critical thinking skills and developing techniques to safely perform minimally invasive procedures. A step-by-step approach via a simulation environment helps the NP learn image guidance, develop hand-eye coordination and become proficient in procedure techniques. Simulation-based education introduces the concept of repetitive practice resulting in the NP gaining confidence in performing procedures while decreasing performance anxiety. The result is a competent NP who can safely perform minimally invasive procedures.
Tech Vasc Interventional Rad 22:26-31 © 2018 Published by Elsevier Inc.

KEYWORDS simulation, training, nurse practitioner, procedures, interventional radiology

Introduction

The American Association of Nurse Practitioners (2016) estimates that there are more than 222,000 Nurse Practitioners (NPs) licensed in the United States working in primary, ambulatory, acute, and hospital practices.[1] Furthermore, NPs in acute care settings have increased dramatically over the last 10 years.[2] Interventional Radiology (IR) is a highly specialized acute care setting in which NPs are establishing themselves as an integral part of the practice. The IR NP role involves clinical care and preparation of the patients prior to procedure through comprehensive assessments, clinical work-up, and follow up care. However, aside from general core competencies of assessment, diagnosing, and clinical management of patients, NPs in IR are increasingly performing a limited number of minimally invasive procedures as allowed by their graduate training, certification, scope of practice, and privileges. The opportunity to incorporate simulation-based training while transitioning into practice, offers the NP additional knowledge and skillset to successfully provide quality care that is safe, efficient, equitable, timely, effective, and patient-centered.[3]

NPs performing minimally invasive procedures require exposure to the procedure environment with dedicated interventional radiologists who are willing to guide, mentor, and assist in training NPs to safely perform procedures. Since it is common for NPs to be exposed to the specialty through on-the-job training, the collaboration between physician and NP needs to be symbiotic for the successful development and integration of the IR NP's role.

Interprofessional Collaboration

In healthcare, interprofessional collaboration plays an integral role in improving patient care, safety, and communication. Publications describe that interprofessional education of healthcare professionals through simulation is an effective

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1089-2516/14/$-see front matter © 2018 Published by Elsevier Inc.
https://doi.org/10.1053/j.tvir.2018.10.006

means to enhancing learning and patient outcomes.[4] Simulation-based education of NPs, effective collaboration and communication between the teacher (ie, interventional radiologist) and learner (ie, NP) results in new knowledge, competency, increased confidence and delivery of quality patient care. Furthermore, interprofessional collaboration among teams is necessary and although sometimes complex, it improves patient outcomes.[5]

Fundamental Concepts: Didactic

Learning fundamental concepts of interventional radiologic procedures is a key prior to simulation-based training. An NP transitioning into an IR practice needs to understand the medical and clinical aspects of interventional procedures, from underlying conditions, risks, and benefits to postprocedure care and management of complications. A variety of textbooks, journals, online resources, and evidence-based publications exist to help gain knowledge and understand the various aspects of the IR specialty.

Fundamental concepts of IR relevant to the NP role is understanding the basics of imaging such as ultrasound, and independently be able to identify relevant images pertinent to the procedures he or she will be performing. For example, NPs who gain competency in performing ultrasound-guided paracentesis, will need to be able to learn and identify fluid on imaging to successfully perform such procedures.

Case Observations

Prior to hands-on training via simulation, it is important for the NP to spend time observing interventional procedures. First, he and/or she need to understand the dynamics of the procedure environment. This includes learning of the different roles of all IR team members in the procedure room (ie, radiology nurse, physician, and technologist). In addition, the NP needs to become familiar with the procedure environment and the dynamics involved in interventional procedures. Case observations allow the opportunity to learn about setting up and maintaining a sterile environment, adhering to radiation safety protocol, and observing techniques utilized by the interventional radiologists while performing procedures.

Sterile Technique

Although an NP may have had exposure to sterile technique through clinical rotations and/or past nursing experience, it is never a waste of time to refresh his or her skills on sterile technique. Patient safety is of the utmost importance in the procedure environment and it begins with ensuring proper protocol is followed in prepping the patient and back table, gowning and gloving, and maintaining sterility while performing a procedure. Second, the NP should observe the same interventional procedure multiple times. Observation of cases can and should be incorporated into the competencies. He and/or she will begin to understand the concepts behind the techniques utilized by the interventional radiologist to successfully perform the procedure with the desired outcome.

Radiation Safety

Anyone working in an imaging and/or IR setting needs to undergo radiation safety training. It is no surprise then that an NP who joins an IR practice will need to undergo mandatory orientation of safety precautions as required by their facility or practice. Understanding key concepts on how to protect oneself when assisting in cases that require fluoroscopy will help minimize exposure to oneself as well as the patient. Protection means wearing appropriate lead apron and eye wear, distance and shielding.

Procedures

The transition from observer to performer takes time, training, and competency. For the NP transitioning into an IR practice, observing the techniques utilized by the interventional radiologist on how a procedure is performed and assisting in cases are 2 methods that help the NP to learn concepts on performing procedures competently and safely. The time spent in cases with the interventional radiologist creates opportunity to gain knowledge, ask questions, and begin hands-on techniques.

Simulation-Based Training

Before the NP can safely perform identified interventional procedures as outlined in his or her practice privileges, he and/or she must attain competency. Focusing on procedure-based training inclusive of fundamental competencies of the nurse practitioner and integrating key aspects of vascular IR, a simulation-based training program of procedure competencies can be developed. As stated earlier, case observations are a great way to begin exposing the NP to the variety of procedures he and/or she will be trained to perform. The next step is simulation training. Loomis (2016) described that simulation has been part of medical education training since the mid-1960s.[6] Present day, simulation-based education can be found within other disciplines, such as in nursing education. This form of education has the benefit of a learner-based approach and case-based scenarios with simulation offering nursing professionals the opportunity to gain knowledge and skillsets that will be impactful in the practice environment. Incorporating simulation develops critical thinking skills for the provider to be able to improve clinical performance.

Hands on Simulation

The Basics

Upon completion of facility and department orientation and the NP has observed sufficient number of procedure cases (as identified by collaborative interventional radiologist and privileges), the next step would be the "hands on" simulation educational training. Early simulation sessions should focus on hand-eye coordination. For the NP that will be performing procedures such as vascular access for Peripherally Inserted Central Catheter (PICC) or tunneled catheter placements and paracentesis, understanding basic ultrasound imaging is the first step. The interventional radiologist becomes the educator who works closely with the NP to help him or her learn and interpret basic ultrasound imaging

while identifying pertinent anatomy (ie, upper extremity veins for vascular access or abdominal ultrasound for drainage access). Below are examples of ultrasound evaluation of upper extremity anatomy during a PICC placement procedure (See Fig. 1) as well as an ultrasound view of abdominal ascites prior to paracentesis procedure (See Fig. 2).

Learning the basics of ultrasound imaging is operator-dependent. Although it is relatively considered safe, it may take several sessions for the NP to feel confident and understand the concepts of basic ultrasound imaging. Once the NP is competent and comfortable in interpreting basic ultrasound imaging, the next step entails hands-on approach to practicing coordination of the hands to be able to perform the access technique for the procedure while viewing the ultrasound screen. The basic of ultrasound consists of becoming familiar with equipment and practice utilizing the ultrasound probe to identify target area for access. Literature suggests 3 components of ultrasound competence——technical aspects of performance, image perception, and interpretation along with medical decision-making.[7] Simulation training can offer opportunity for the NP to manipulate imaging equipment, utilize mannequins or phantom limbs to practice hand-eye coordination.

Developing Hands-On Skillsets

Simulation training of the NP focuses on a variety of skillset procedures. As mentioned earlier, once the NP has understood the concepts of basic ultrasonography relevant to the procedures he and/or she will be performing, simulation can then focus on the skillsets (ie, vascular access, drainage procedures, soft tissue biopsies, and suturing). This is the time when repetitive practice comes into play. The more time the NP spends in the simulation lab practicing, the more he or she will gain critical thinking skills, competency, and confidence.

Deliberate Practice in Simulation-Based Training

Simulation introduces real world concepts in a practice environment. For the learner, the goal is to develop proficiency in technical skills while understanding the fundamental theories. The strategy of simulation-based training that couples skills experience with clinical reasoning is deliberate practice.[8] The main objective of deliberate practice is repetition. Simulation allows for the repetitive practice of skills and/or clinical scenarios which lead to the mastery of competent performance in a short time. Training on each component of a technique specific to a procedure leads to improved motor skills and critical thinking about how to perform efficiently for the intended outcome. For medication education training, simulation with deliberate practice has been utilized to improve physicians' clinical skills through medical simulation settings that transfer directly to improved patient care practices and better patient outcomes.[9]

Figure 1 Ultrasound view of upper extremity vessels.

Figure 2 Ultrasound view of abdominal ascites.

For the NP that is training to master skillsets to competently perform IR procedures, utilizing simulation with deliberate practice will help him or her master the necessary skills in a shortened time. For example, the NP who has a busy clinical practice day may be limited to performing 1 or 2 vascular cases due to other role responsibilities. This can hinder his or her ability to master vascular access technique. However, with simulation-based training and incorporated deliberate practice, the NP can utilize an ultrasound system, phantom equipment (ie, upper extremity mannequin) to practice visualization, and hands-on puncture technique (access) repetitively, such as 10 tries, leading to mastery faster than performing only 1 or 2 cases on any given day in the clinical practice setting (See Figs. 3-6).[10]

Controlled, deliberate practice with feedback are highly effective at promoting skill acquisition and generalizing

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Figure 4 Reprinted with permission. VATA's vascular access ultrasound use, item #0705 by VATA, Inc., www.vatainc.com.

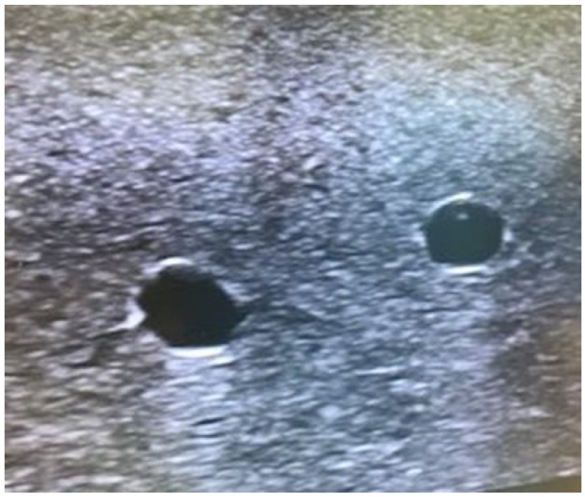

Figure 5 Ultrasound view of vessels.

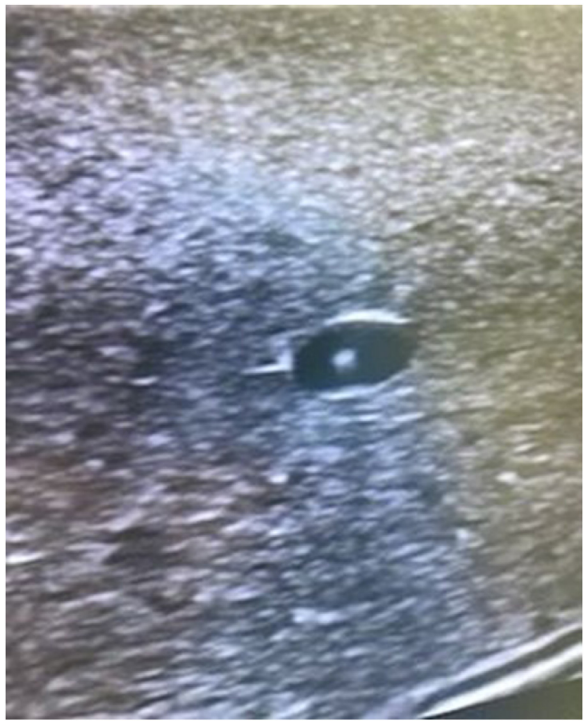

Figure 6 Ultrasound view of needle within vessel.

simulation-based learning into patient care settings among medical learners.[11] For NPs this method of practice can assist in a successful transition into practice. Deliberate-practice gets learners into the habit of practicing and thinking about practicing while realizing the need of how to improve their technique.[12]

Clinical Training Scenarios

In addition to understanding clinical reasoning and improving skills, deliberate practice compliments real world experiences. The opportunity to train on high risk, low incidence

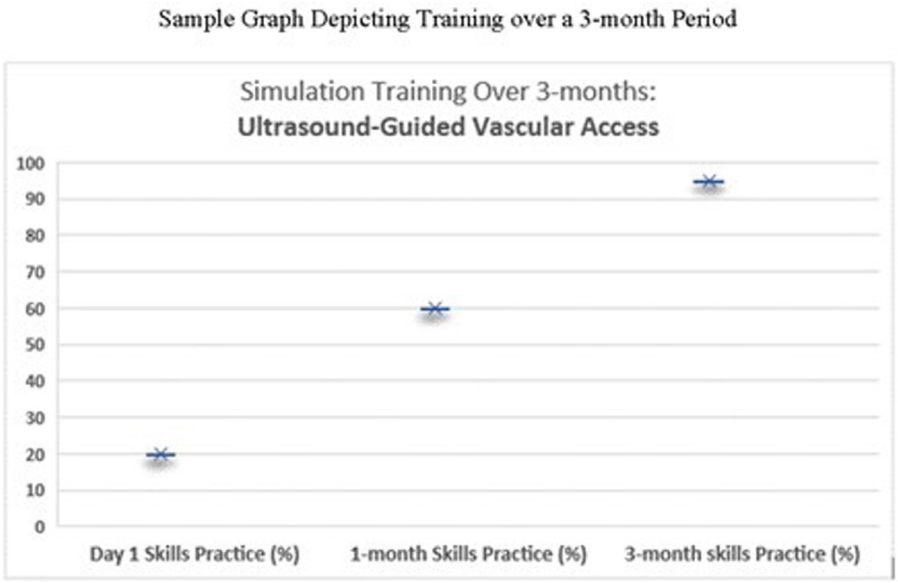

Figure 7 Sample graph depicting training over a 3-month period.

Table 1. Simulation-Based Training: Sample Checklist of Procedure Competency

Level of Performance	How Competency is Measured	Action Plan/Review (*If trainee is not competent an action plan must be indicated*)
1) Met objective 2) Met objective with minimal assistance 3) Objective not met*	• Direct observation • Video review/testing • Skills lab/training • Immediate feedback postskills practice • Other	■ Review text/didactic concepts ■ Independent practice ■ Instructor-led practice ■ Video/discussion

Self-Assessment		Procedure	Instructor's Evaluation	
Performance level	Date	Procedure Specific Competency Checklist	Measure	Competency level
		Understands clinical indication for procedure		
		Understands contraindications for procedure		
		Ability to discuss and explain risks, benefits and potential complications of procedure		
		Able to identify and understand the equipment and medication to be used throughout procedure		
		Utilizes sterile technique throughout procedure		
		Demonstrates proper hands-on technique in utilizing imaging equipment (ie, ultrasound) for access • Able to locate anatomical location relevant to procedure		
		Ability to troubleshoot if unable to obtain access after first attempt		
		Understands potential complications		
		Exhibits ability to manage complications		
		Able to develop appropriate treatment plan and orders post-procedure		

*Performance levels 2 and 3 require additional training and education. Action plan should be developed and discussed with trainee.

IR events can better prepare the NP to participate in life-saving treatment of patients experiencing an unexpected event. Contrast reaction is an example of a high risk, low incidence event within the IR setting. A patient can present with a high-risk case of anaphylaxis after administration of contrast. The timeliness of the intervention can mean life or death for the patient. In this such case, the NP and all members of the IR team, need to be prepared to intervene on the patient's behalf to prevent or minimize negative outcomes. Simulation training with deliberate practice offers the opportunity for the NP to engage in performance followed by immediate feedback and opportunities for repetition.[8] Other clinical training scenarios such as advanced cardiac life support via simulation offer opportunities for the NP to develop critical thinking skills in managing a code, appropriate medication administration and evaluation of patient's status throughout intervention.

Attaining Competency

The goal of simulation-based training is to ascertain that the IR NP has achieved an expert-performance approach through simulated scenarios and repetition (deliberate practice). Methods for establishing competency should be developed from the beginning of the NP's training. The importance of self-assessment and teacher evaluation at the beginning of training will provide a baseline for which to compare as the simulation training progresses.

A time frame should be established for the NP trainee to attain competency. Initial demonstration, number of hands-on assisted sessions, and independent practice should be established. The key to successful simulation training is immediate feedback and opportunities for hands-on repetition. Documentation and interpretation of competency can be established via a checklist that incorporates specific categories (see Table 1). Competency attainment can be monitored throughout the training process. Periodic evaluation utilizing a graph can demonstrate overtime if the NP is gaining skills and clinical reasoning with repetitive simulation practice (See Fig. 7).

Summary

An IR practice who is looking to incorporate NPs into their practice should establish a simulation-based training program that offers opportunity for case observations and skills practice along with evaluative methods. Such a training program will develop confident NPs that competently perform IR procedures safely. The method of deliberate practice as part of simulation-based training is ideal for NPs entering specialty practice, such as IR. Through deliberate practice, the repetition of tasks in a given time frame leads to rapid acquisition of skills allowing the NP to transition quicker and safely in performing procedures. The concept of repetitive practice, immediate specific feedback and correction results in a better skills performance in a controlled setting.[11] The dedication of time and resources to provide specialized training of specific skills to IR NPs through simulation-based training with deliberate practice, can result in a successful transition into practice. The conclusion of training results in a successful collaborative provider approach to patient care within the IR setting.

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