Techniques in Vascular and Interventional Radiology

Climbing the Mountain: Value of Simulation in Interventional Radiology Training

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A major challenge most medical teaching institutions encounter is providing a balance of trainee education while maintaining patient safety and optimizing team performance. Patient safety remains a known issue within medical education, Interventional Radiology (IR) included. Approximately 10% of patients admitted to a hospital encounter some form of iatrogenic harm.[1] As reported in the Institute of Medicine's *To Err is Human: Building a Safer Health System,* published in 1999, medical errors are responsible for up to 98,000 hospital deaths each year in the United States while half of all surgical adverse events are preventable.[2] Per a 2016 John's Hopkin's University survey, medical errors are the estimated third annual leading cause of death, behind heart disease, and cancer.[1]

Trainee-related medical errors certainly contribute to patient morbidity and mortality. The steep learning curve in achieving technical proficiency further confounds medical education in IR. The steep curve has in turn resulted in procedure-related complications contributing to higher patient mortality rates. The commonly quoted Halstead Apprentice medical education model of "*See one, Do one, Teach one*" is slowly losing grounds in the evolving healthcare environment of decreasing trainee exposure to procedures secondary to work hour restrictions, public perception of trainees, and rapid evolution of new techniques/modalities in IR. However, the crux of graduate medical education remains to promote active learning over passive learning. This is based on the thought that trainees remember 90% of what they do compared to 50% of what they see and hear while building a better foundation to analyze, create, define, and evaluate medical management.[3]

Current active teaching options for technical proficiency include performing procedures on patients, animals, and on simulation models. With changes in healthcare over the last decade, it is critical to understand the implementation and demands of the present value-based care. Patient outcomes and care costs are key components to optimizing value. Examples of such factors effecting value include reduced number of complications and readmissions, shorter procedure times, reduced ambulation time, etc. Simulation-based curricula for IR trainees may fill a portion of this gap. Simulation training has been shown to improve technical skills in other medical fields. The Fundamental of Laparoscopic Surgery training program produced higher performance scores for surgical residents performing laparoscopic cholecystectomy.[4] Furthermore, a Cochrane review of the effectiveness of Virtual Reality training in laparoscopic surgery, based on 23 trials with 622 participants, confirmed that Virtual Reality training decreased time taken, increased accuracy, and decreased errors in laparoscopic surgery.[5] Simulation in colonoscopy also yielded educational benefit including safer operation, requiring less senior assistance, ability to better define endoscopic landmarks, and reach the cecum independently on more instances than traditionally trained fellows during the initial part of the learning curve.[6] In 1 hour of Bronchoscopy simulation, inexperienced residents had improved performance in technical basics compared to peers without similar training, and were on par with more experienced residents.[7]

Current data to support simulation training application to IR education can be extrapolated from simulation training in ultrasound phantoms which have led to improvement in technical skill acquisition.[8] Additionally, a comparison of 16 Vascular Surgery trainees before and after simulation based Endovascular Aortic Repair training showed decreased procedure time to 56 minutes in simulation scenarios vs 77 minutes with an improved independent Likert scale of procedure performance. Fewer Endoleaks were found in the group that underwent simulation training, 12.5% vs a baseline of 50%.[9]

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Aside from the technical components of simulation and its proposed benefit, other important components to simulation education implementation include a faculty simulation champion, identifying time for simulation education, incorporating active learning into curricula, developing task trainers, and developing scenario-based teaching. This teaching approach is first applied to basic technical concepts such as the Seldinger technique and knot tying with further incorporation into more advanced techniques such as ultrasound guidance and angiography simulation. Finally, simulation can be used to address team communication issues. Care teams function in silos and effective teamwork plays a large role in the delivery of safe, high quality patient care. Barriers such as failed communication, ineffective interpersonal skills, interprofessional tension, poor team interaction, and differing interpretations of quality of collaboration impact patient care. Hence, the Joint Commission and the Agency for Healthcare Research and Quality have made teamwork training a priority. Simulation can improve team communication as evidenced by a survey performed after a local simulation team training event showing.

Simulation is of vital importance to procedural and clinical IR training, demanded by our evolving healthcare environment of value-based care and persistently high medical error rates. The issue will cover different methodologies that can be used for IR simulation education as well as their future potential impact.

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