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EDITORIAL COMMENT

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Medical simulation in interventional cardiology: “More research is needed”

Peter Tajti, MD[1,2] | Emmanouil S. Brilakis, MD, PhD[1]

[1]Minneapolis Heart Institute, Abbott Northwestern Hospital, Minneapolis, Minnesota
[2]Division of Invasive Cardiology, Second Department of Internal Medicine and Cardiology Center, University of Szeged, Szeged, Hungary

Correspondence
Emmanouil S. Brilakis, MD, PhD, Minneapolis Heart Institute, 920 E 28th Street #300, Minneapolis, MN 55407.
Email: esbrilakis@gmail.com

Key Points

- Medical simulation is being used for training fellows to perform coronary angiography.
- Medical simulation training was associated with 2 min less fluoroscopy time per case after adjustment.
- Whether medical simulation really works needs to be evaluated in additional, well-designed and executed clinical studies.

Training cardiology fellows to perform coronary angiography has traditionally been performed by observing cases and gradually performing the clinical tasks involved (obtaining arterial access, engaging the coronary arteries, injecting contrast and obtaining appropriate views, and achieving hemostasis). Training usually takes place during the first year of fellowship, with the advanced fellows often teaching younger fellows later during the course of fellowship (“see one, do one, teach one” concept). This training process is not perfect (there is risk for complications, the quality of education varies depending on the instructors and trainees, and it may be lengthy), but it works. Medical simulation can replicate some of the tasks required during cardiac catheterization and, as a result, allow teaching and practice without exposing patients to risk for complications and being flexible to accommodate each person's learning pace. Several simulators have been developed for coronary angiography and percutaneous coronary (as well as peripheral and structural) interventions, but there is limited data on whether and to what extent they are beneficial [1].

In this issue of the journal, Prenner et al. report their experience with use of the Procedicus VIST@-C endovascular system (Mentice, Gothenburg, Sweden). The system was used for 6 months (January to June 2013) at the Northwestern Memorial Hospital to train 12 fellows, whose procedural metrics were compared with 20 fellows who were trained between 2011 and 2015 without use of simulation [2]. Analysis was challenging due to growing use of radial access during the study period, but after adjustment fluoroscopy time was shorter by 2 min in fellows who had simulation training as compared with those who did not. There was minimal or no difference in fluoroscopy time among cases performed via femoral access, with the differences being concentrated in radial access cases.

What are the lessons from the study? First, the learning curve for cardiac catheterization via radial access is steeper than via femoral access. Approximately 30–50 cases are needed to achieve initial competence for procedures performed through the radial artery [3]. Second, simulation training can shorten (although slightly) this curve. Third, the time used for simulation training in the present study (3 hr) was small. The study has several weaknesses: non-randomized, design, controls from various time periods antedating and postdating the simulation training, combined didactic and simulation training during the same training session, change of access site patterns during the study, no data on complications, and no data on the quality of angiography. Improved simulators and simulations are also needed: the system used in the present study provides training on catheter engagement but does not include an X-ray gantry or real-time feedback on using optimal angulations, or avoiding using X-ray when not looking at the screen. It also does not provide training on how to obtain arterial access. Even though it appears improbable that simulation would teach the fellows harmful habits and adversely impact their developing skills, in a prior study in Sweden simulation training was associated with longer fluoroscopy time (360 [IQR 245–557] min vs. 289 [IQR 179–468] min, $P < 0.001$) and higher rate of complications (4.33% vs. 1.86%, $P < 0.001$), particularly when femoral access was used (6.25% vs. 2.53%, $P < 0.001$) [4]. Even if simulation training reduces fluoroscopy time for each trainee, this reduction will likely be limited to the initial training phase, since growing clinical experience would probably efface any differences in procedural efficiency gained by simulation over the long run.

Should simulation training be universally implemented for training in cardiac catheterization? The answer in our opinion is “not quite yet,” as it is unclear at present that the anticipated benefits exceed the associated risks and costs. Anticipated benefits include lower radiation dose [5], potential avoidance of complications, and less stressful learning experience for the trainees. However, the supporting data is limited and weak. Moreover, there is a risk that the simulator may provide suboptimal or non-realistic training resulting in trainee over-confidence and worse clinical outcomes. The simulator cost is currently approximately $90,000, which is a steep price tag for many institutions to cover in this era of declining reimbursements and for an essentially unproven intervention. However, cost could decrease, for example by sharing a simulation among multiple institutions or leasing it for a few days every year, given fellow rotation. Also, preventing even a few complications could quickly recover the cost of the device.

"More research" may sound cliché, but is what the field of simulation in interventional cardiology truly needs. While the authors should be congratulated for providing data in this rapidly evolving field, additional high-quality studies are important to guide further development and implementation of medical simulation.

CONFLICT OF INTEREST

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ORCID

Peter Tajti MD http://orcid.org/0000-0002-3449-7604
Emmanouil S. Brilakis MD, PhD http://orcid.org/0000-0001-9416-9701

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