AN INTERVIEW WITH...

Isabelle Van Herzeele, MD, PhD

Prof. Van Herzeele discusses the current use of simulation technologies for endovascular training and procedure rehearsal, as well as ongoing work to improve radiation safety.

What was a key theme or message of the recently held 10th Congress of the Dutch Society for Simulation in Healthcare (DSSH), and what were some of the highlights of the meeting?

The key theme of our 10th annual Congress of the DSSH was "Time for Change?!" to discuss why health care has still not embraced simulation as the main tool for training and assessment. The answers were discussed by three outstanding keynote lecturers. Prof. Guid Oei, who is Founder of the DSSH, explained how simulation was introduced into health care, and more importantly, into his daily practice as an obstetrician/gynecologist. He shared his personal testimony about how it has improved the technical skills and team performance in high- and low-income countries with better patient outcomes.

At another session, Prof. Jeroen van Merriënboer discussed the four-component instructional design (learning tasks, supportive information, procedural information, and part-task practice) that may be particularly useful when designing educational games (known as "serious gaming") that have complex learning objectives.

Finally, Dr. Stefan Mönk gave us his personal view on why simulation in health care has not been widely accepted nor integrated in daily practice. Although research has proven the positive impact of simulation technology on patient care, stakeholders still need to be convinced, areas for improvement need to be identified within the hospital, and team training sessions should not negatively affect the income of health care workers or hospitals. He proposed that serious gaming may be a solution for learning and maintaining accreditation, may be used to prepare crew resource management training, and suggested that not every hospital should run its own skills or simulation lab but that simulation could be a service provided by industry.

Are there any major ongoing studies or forthcoming data that we should be aware of in terms of the utility of the various simulation training technologies and protocols for use in endovascular interventions?

The following are some studies that I am aware of that are currently in progress or to be initiated by our group, EVEREST (European Virtual Reality Endovascular Research Team).

At Zurich University hospital, a single-center prospective study is in progress to evaluate the impact of patient-specific simulation in ruptured abdominal aortic aneurysms (AAAs), which is being led by Prof. Dr. Mario Lachat. At Imperial College London, weekly endovascular team training sessions in the simulated high-fidelity angiosuite are being organized by Ms. Celia Riga and studied to evaluate the impact on team performance in daily practice.

The PROSPECT registry will evaluate whether the positive outcomes of virtual histology intravascular ultrasound on the performance of endovascular procedures by surgical trainees when treating atherosclerotic Iliac or superficial femoral artery lesions in the PROSPECT trial[1] can be reproduced in other hospitals and other countries. Trainees will be recruited at the University Hospital of Leuven and Ghent in Belgium and of Lille and Nancy in France.

Finally, in collaboration with Dr. Teodor Grantcharov's group at University of Toronto, the operating room black box (ORBB)[2] will be installed in the hybrid angiosuite at Ghent University Hospital. Similar to a flight recorder on an airplane, the ORBB captures a wide range of information, including panoramic audiovisual data, equipment and sensors in the hybrid angiosuite, radiation dose to the patient and team members, and adverse events and patient outcomes in the hybrid angiosuite during (endo)vascular procedures to identify high-risk interventions and characterize events leading to errors in order to detect areas for improvement. The goal is to improve patient safety and make the hybrid angiosuite a better and safer working place for all health care professionals.

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Can you give us an overview of how patient-specific emergency endovascular aneurysm repair (EVAR) simulator rehearsal is undertaken given the often time-sensitive nature of these presentations?

Patient-specific simulation in emergency situations is similar to elective endovascular repair of infrarenal AAAs.[3,4] The preoperative CTA images are uploaded, and a three-dimensional (3D) reconstruction of the patient's relevant anatomy is created using the Procedure Rehearsal Studio software (3D Systems, Inc.). This 3D model forms the scaffold for the patient-specific simulations. Subsequently, a virtual reality simulator (Angio Mentor, 3D Systems, Inc.) is used to conduct the procedure-specific rehearsals. The key to success is to have a team made up of one person creating the patient-specific simulation while another person manages the patient and logistics at the hospital. A good-quality CTA with contrast and maximum 2-mm-slice thickness makes the reconstruction straightforward and fast. The 3D model can be created while the patient is still being transferred. It is also helpful to have a ruptured AAA management protocol within your institution. Several patients are and will remain hemodynamically stable if the principles of permissive hypotension are respected, allowing sufficient time not only to create the patient-specific simulated scenario but also to rehearse it.

During the rehearsal, you can evaluate the optimal C-arm angulations to visualize the landing zones, evaluate your plan (introduction of the main body and ease of cannulation of contralateral limb), and predict potential pitfalls. We have mainly used the Endurant (Medtronic) and C3 Excluder (Gore & Associates) devices during these patient-specific rehearsals because most EVEREST members have these devices on the shelf. Soon, we hope to be able to use the 3mensio system (Pie Medical Imaging) for this purpose, which is our dedicated workstation, and to upload these files directly onto the virtual reality (VR) simulator, saving precious time.

Currently, patient-specific rehearsal is mainly used during treatment of infrarenal AAA, but it is also available for thoracic EVAR,[5] and I am convinced that this technology along with 3D printing will rapidly evolve, allowing physicians and health care workers to practice every case before treating the actual patient. This will require a constructive collaboration between the simulation companies, device industry, and implanting physicians.

What do you see as the role of simulation for carotid intervention in 2018?

Carotid artery stenting (CAS) is a high-risk procedure, especially when treating symptomatic lesions, and should ideally be performed in centers of excellence. On the other hand, transfemoral CAS has become less popular, but opportunities to teach and expose sufficient numbers of trainees to this technique should be preserved to ensure that physicians are able to safely carry out this procedure.

Generic simulation may allow trainees to become familiar with the carotid toolkit, learn how to navigate safely in the aortic arch and branches, execute the procedural steps, use cerebral protection devices according to instructions for use, and accurately deploy stents. Acute stroke management, an even more stressful procedure due to time pressure, is also available on various simulators and may not only be beneficial for technical skills training but also to improve team interaction and performance.

Patient-specific scenarios can be created preoperatively, especially for less experienced endovascular teams, so that they have more insight into the patient's anatomy, are able to rehearse the procedure, can identify the optimal C-arm angulation, and determine possible pitfalls. Additionally, it can be done postoperatively to allow other team members to treat the same type of case or debrief about CAS procedures or acute stroke interventions with excellent or poor outcomes.

The implementation of newer devices in real life (cerebral protection, balloons, stents, etc) should ideally be preceded by hands-on training on simulation modules (plastic, flow model, VR simulator) prior to treating actual patients, no matter the experience level of the implanter and his/her endovascular team.

Where does the rise of consumer technology such as VR viewers fit into the current (and future) simulation and training landscape? How about the path ahead for 3D printing to practice on patient-specific models?

The augmented reality of wearing a VR headset to provide a 360° view of the immersive operating room setting is already popular in laparoscopic surgery and in the accident and emergency department. It may allow trainees not only to learn technical skills but also teach them how to cope with the stress and distractions that may occur in real-world situations. These VR headsets may be used with various types of simulators, and in the future, multiple members wearing this technology at the same time can participate in team training sessions during elective and urgent procedures (eg, ruptured aneurysm, stroke management, resuscitative endovascular balloon occlusion of the aorta in trauma) while being in the same or even different locations.

The use of 3D printing is already increasing in both open and endovascular management of complex aortic aneurysms, and I am convinced that it will become routinely used in open surgery, but may be replaced in the endovascular field by virtual patient-specific modules once these are able to mimic these challenging real-life situations. Keep in mind that endovascular devices to treat the pathology of an actual patient may be printed and tested in a simulated environment before implanting them in real patients.

Regarding the recent findings on consensus for key competencies for radiation protection, are there plans to implement them into training courses or create a guidelines document? What was the most surprising finding of these results?

This consensus was the first step of a project to increase the awareness about radiation safety within health care and is the result of a close collaboration between the University Hospital of Nantes, France; the Royal Free London NHS Foundation Trust; and Ghent University Hospital, Belgium, and of course the contributions of the PRET (Principles of Radiation Protection With Endovascular Team) group. Some surprising findings were that no consensus was reached for the following practices: (1) register the administered radiation doses in the patient's file, (2) consider the risk/benefits for each procedure (justification principle), and (3) inform patients of the radiation-related risks. Although operator-controlled imaging during EVAR procedures has been shown to lower radiation doses, experts also did not reach consensus on who should control the C-arm.

Currently, we are developing a massive open online course (MOOC) titled, "Radiation protection in the operating room: the do's and don'ts for health care workers" and will evaluate the impact of this MOOC on participants' knowledge, technical skills, and attitudes toward radiation safety in the workplace. Finally, an assessment tool to evaluate the radiation safety behavior of the various endovascular team members during procedures is in development.

Could video motion analysis (VMA) be applicable in other anatomic settings, aside from coronary interventions, for operator skills assessments? How would you like to see this tool be applied throughout the endovascular field?

Research on VMA is being carried out at Imperial College London, specifically by Dr. Alexander Rolls, supervised by Mr. Colin Bicknell.[6] VMA technology can be used for any arterial intervention that relies on fluoroscopic imaging, as it uses fluoroscopic pixel coordinates to generate data. Coronary intervention was initially chosen to allow data collection across a large group of operators with various experience. The feasibility of using VMA in live cases and differentiation between levels of experience has been shown. Articles are in press about the use of VMA in EVAR and fenestrated EVAR procedures to evaluate the benefit of robotic catheter technology to cannulate the contralateral limb or side branches.

In the future, VMA may be used to assess skills during training, validate assessment tools, or evaluate the safety of new techniques or devices in the vascular tree.

With all of your work in training the incoming generation of endovascular physicians, what is the most important advice you offer them?

I would advise the incoming generation of endovascular physicians to remain open minded for new and old techniques, in terms of evolution in endovascular tools and imaging, because treatments we have today may be completely different within 10 years. Be actively involved in multidisciplinary meetings to discuss indications for endovascular and open treatment, collaborate or be familiar with sizing software, and know how to use overlay imaging in daily practice but do not jeopardize the radiation safety of your team and patients. Look ahead to endovascular robotics, learn when and how to use new techniques and devices in simulated settings, and do not underestimate the power of patient-specific rehearsal (simulation, 3D printing) for the entire team. And last but not least, value your team and keep them involved. ■

1. Maertens H, Aggarwal R, Moreels N, et al. A proficiency based stepwise endovascular curricular training (PROSPECT) program enhances operative performance in real life: a randomised controlled trial. Eur J Vasc Endovasc Surg. 2017;54:387-396.
2. Fecso AB, Kuzulugil SS, Babaoglu C, et al. Relationship between intraoperative non-technical performance and technical events in bariatric surgery [published online March 30, 2018]. Br J Surg.
3. Desender LM, Van Herzeele I, Lachat ML, et al. Patient-specific rehearsal before EVAR: influence on technical and nontechnical operative performance. A randomized controlled trial. Ann Surg. 2016;264:703-709.
4. Desender LM, Van Herzeele I, Lachat ML, et al. A multicentre trial of patient specific rehearsal prior to EVAR: impact on procedural planning and team performance. Eur J Vasc Endovasc Surg. 2017;53:354-361.
5. Desender LM, Van Herzeele I, Rancic Z, et al. Patient-specific simulation of endovascular thoracic aortic repair: initial experience. Ann Thorac Surg. 2017;104:336-341.
6. Rolls AE, Riga CV, Rahim S, et al. Video motion analysis in live coronary angiography differentiates levels of experience and provides a novel method of skill assessment. EuroIntervention. 2017;13:e1460-e1467.

Isabelle Van Herzeele, MD, PhD
Associate Professor
Department of Thoracic and Vascular Surgery
Ghent University Hospital
Ghent, Belgium
isabelle.vanherzeele@ugent.be
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