Bringing Science, Engineering, and Medicine Together to Build Devices: An Interview With Ghassan S. Kassab, PhD

Interview by Jennifer Ford

At the 2016 New Cardiovascular Horizons (NCVH) meeting in New Orleans, Ghassan S. Kassab, PhD, an engineer who has helped to develop a sizing device for interventional procedures, spoke to attendees about the need for collaboration among physicians, scientists, and engineers to create the most effective medical devices.

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VDM: Could you explain why what you do is important for interventionalists to know?

Kassab: I followed an academic career in bioengineering. I recently stepped away from an endowed chair position at Indiana University - Purdue University and founded a nonprofit research entity that is focused on innovation. The crux of that effort is to enable clinicians to collaborate with researchers, scientists, and engineers. Clinicians know the questions to ask - every patient they see presents a question. The engineers and scientists know disciplines that range from nanotechnology to information technology to biomechanics, and can offer solutions to some of these questions in collaboration with clinicians.

I heard Dr. Walker speak last year at NCVH about the "Goldilocks" of sizing for vessels: not too big, not too small, just right. What he has seen in his practice is that if you don't match the prosthetic to the vessel of interest with the right size, you can have issues. Under- or over-sizing can lead to abnormal hemodynamic and, hence, mechanical stresses and strains on the endothelium and vessel wall which can cause restenosis and lumen loss that require retreatment.

Although correct sizing is important for all interventional procedures, there are a number of recent technologies for which correct sizing is very critical for optimal outcome. Although there are a number of imaging technologies that can be used for sizing, they are not used routinely and are considered niche devices. To address this issue, we have been work-

ing on a nonimaging, electrically based LumenRECON wire, a technology that can be carried on any standard guide wire and allows real-time sizing of the reference vessel dimension. There is no training or interpretation required, and it has unprecedented accuracy and reproducibility to measure the dimensions of coronary and peripheral vessels. Dr. Pradeep Nair, MD, of the Cardiovascular Institute of the South has just completed a 24-patient study in peripheral arteries (2 arteries per patient) and he presented that data at the NCVH meeting. He compared the technology to various other modalities. The benefit is that you don't have to ask the clinician to do an added procedure. With IVUS, for example, you have to put in an extra device, interpret the image it provides, get a dimension, pull it out, and then go in with standard therapy. If one can do all that on one workhorse guide wire that takes a second to get a sizing reading and then deliver the therapy over the same platform, then that saves time. And, if one can do it at a fraction of the cost of IVUS, then this technology can become available to the masses.

This is a perfect example of collaboration between clinicians who know the need and are able to identify the question and engineers and researchers who understand certain physical laws and technologies and how they can lend themselves to a solution as per constraints provided by clinicians (for example, choreography of clinical procedures, efficiency, cost, etc.). This intimate association between clinician and research and development will ultimately benefit the patient. I am seeing an ever-expanded interest of clinicians in science and engineering that can be brought to bear to address their clinical problems. I appreciate that Dr. Walker encourages this among NCVH attendees as this will ultimately help patients.

VDM: Can you share some other examples of how this collaboration has worked?

Kassab: I've mentioned the integration of diagnostic with therapy delivery but I can also give an example of therapy. For patients who have critical limb ischemia, particularly those at risk of amputation, we have been working out ways of mimicking the embryology of how veins are transformed into arteries with a simple elevation of hemodynamic cues through a percurtaneous catheter-based approach. Many patients have existing veins that are quite redundant and still quite healthy, because atherosclerosis is not a disease of the veins. No matter how much atherosclerosis we have in our arteries, the veins tend to lack atherosclerosis. So, for patients whose arteries are diseased beyond repair, beyond bypass surgery or intervention, we are working to develop an approach where we transform some of those veins into arteries so that we can perfuse the limbs of those patients.

Again, this is based on the notion of understanding the basic science, understanding the embryology of how cells can be transformed from one phenotype to another depending on their local function and marrying that with real-life problems. Clinical feedback in defining the state of those patients, their comorbidities, anatomies and hemodynamics are all key to devising the proper solution. We start

out with clinical input from the very outset because the clinician understands the patients and questions far better than the researchers ever will as they are dealing with patients every day. Not only that, but the clinician is also the user. So, I can come up with what I believe is a fantastic solution, but if it disrupts the choreography of clinical practice, if it's too cumbersome, if it adds substantial time to the procedure or is not cost effective (because clinicians understand the pressures of their cath lab managers), we won't have a successful device. Those are the things we want to interject very early on into the solution. Technically speaking, clinicians help us describe the boundary conditions and the requirements for the solution. Our approach to innovation seminally relies on clinicians.

VDM: How do you think this type of collaboration could grow?

Kassab: We could enhance these types of collaborations by including sessions at clinical meetings that cross-fertilize biology, engineering, and medicine. Topics of biology such as endothelial and smooth muscle cells in conjunction with topics in abnormal hemodynamics are intimately relevant to thrombosis, intimal hyperplasia, and atherosclerosis. I think having a place where the clinicians come together to share ideas with basic biomedical researchers and engineers is the beginning. Ultimately, the pictures of success come from the various disciplines working hand in hand. What I'm describing is certainly not novel, but I think it needs to be done more systematically and more often. Clinical meetings such as this with so many capable leaders in attendance can be a wonderful platform to accomplish this cross-fertilization. ■

Editor's note: Dr. Kassab reports that he is the founder of the sizing technology mentioned in this interview..