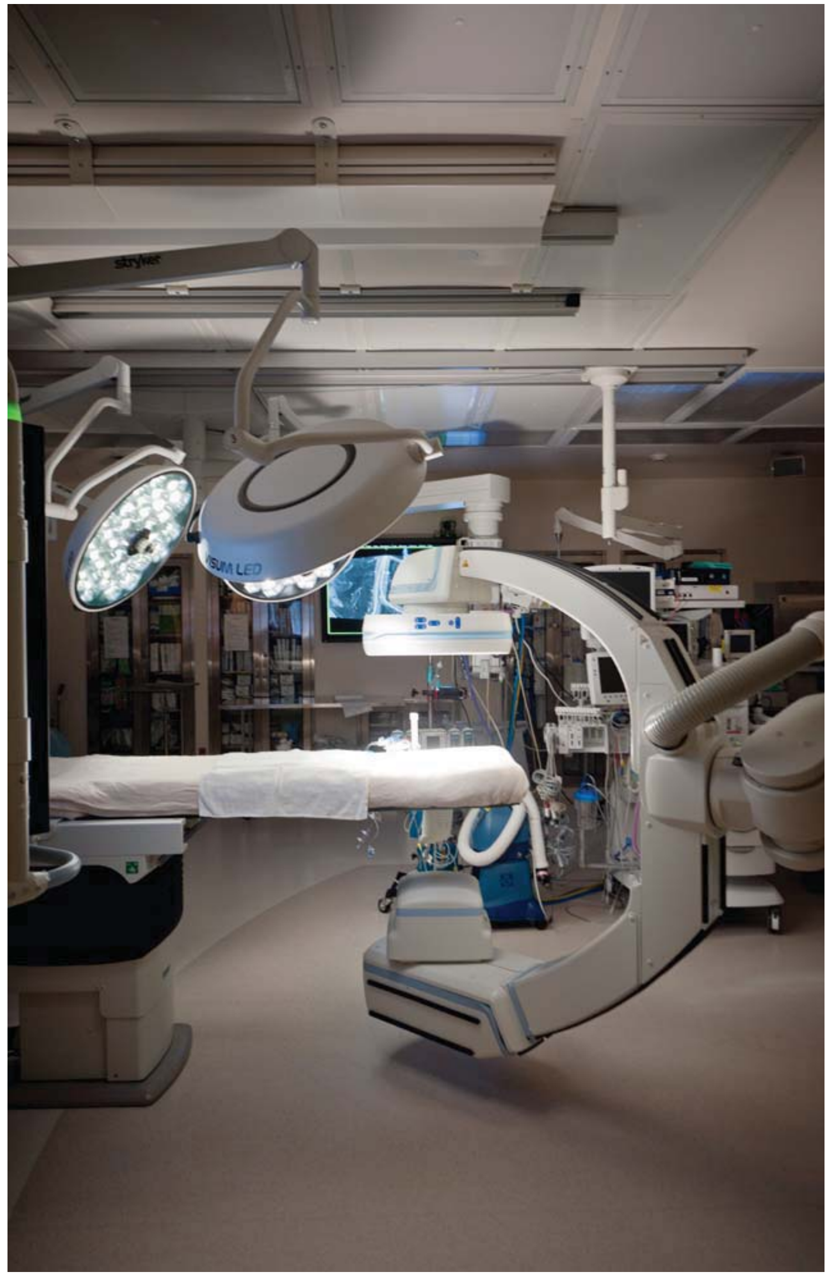
3D Imaging Brings a New Vision to Endovascular Surgery

Alan Lumsden, MD, a leader in the field of endovascular surgery, is Medical Director of the Methodist Hospital DeBakey Heart and Vascular Center Houston, Texas and Professor and Chairman of the Department of Cardiovascular Surgery at the Methodist Hospital, Houston, Texas. Lumsden, who has received more than $1.8 million in research funding and has contributed more than 300 papers to the medical literature, says 3D imaging in the operating room, robotic catheter guidance, and other advanced technologies have the potential to revolutionize endovascular surgery by improving accuracy as well as safety.

By Sameh Fahmy, MS

> "We had angio suites, but we didn't have CT scanners in the angio suite until *syngo* DynaCT. Now we have a whole new set of imaging modalities that we can work from."

Alan B. Lumsden, M.D.,
Medical Director Methodist Hospital
DeBakey Heart and Vascular Center,
Houston, Texas, U.S.



A look into the new hybrid OR featuring Artis zeego.

Which early advances in imaging have been most consequential for surgeons?
The single most important piece of equipment was the portable C-arm. That has, in my opinion, transformed what we could do. No hospital is going to invest three or four million dollars in building a hybrid room before you had significant patient volume and reimbursement to justify building that. The next level really was fixed imaging suites in the operating rooms. Or I should also say, access to fixed imaging, because not all of them are in the operating room.

Tell me about some of the more recent milestones in imaging.
I think the next one is *syngo* DynaCT image fusion; that's the next revolution that's about to take place. We had angio suites, but we didn't have CT scanners in the angio suite until *syngo* DynaCT. Now we have a whole new set of imaging modalities that we can work from.

Can you give me an example in which *syngo* DynaCT is particularly beneficial?
Type II endoleak management is one example in vascular surgery. Another example would be for the thoracic surgeon. Rather than having a patient undergo a needle biopsy, and possibly bringing the patient back for a scope if the needle biopsy is non-diagnostic and then having a third procedure to resect the tumor, I think it could all be done in one shot. You could import the initial CT scan, fuse it on top of the patient, use something like *syngo* iGuide (integrated needle guidance), stick a needle in it for a biopsy, send it to the pathologist, keep the patient asleep, look at it. If it's non-diagnostic, we're going to stick a scope in there, take a biopsy, and send it to the pathologist. And if it's a lung cancer, it needs to be resected and it's going to happen right there. I think the technology is transformational.

How can 3D imaging aid procedural planning?
Let me give you a vision, although the pieces aren't all necessarily meshing together yet. One of the advantages of *syngo* DynaCT is 3D reconstruction, but we don't look at it in 3D. We have a 3D rendering on a 2D model. We would really like to be able to look at that 3D image and interact with it in 3D with tools that allow us to plan the operation. We would then push it to the simulators and practice on Mrs. Smith's renal artery angioplasty today. We could then take that same data set and push it to the Artis zeego tomorrow, fuse it on top of the patient and do the procedure having planned it three-dimensionally in a cave environment and having practiced on our simulator. Now you may not have to do this in every case, but it's the opportunity to do this on the more sophisticated cases that's significant. And the final part of this, and this is several years away, is using flexible catheter robotics. Can we automate parts of this? Because that same centerline that we've used down the middle of the aorta to measure a length for an endograft could be a guide path for a robot. And that's not that far away. We have the catheter robots and are really interested in this interface between 3D navigation, which you can pinpoint with a robot, and the 3D imaging that Siemens provides.

What are some benefits of the robotic movement of the Artis zeego?
Right now, I think it's the ease of positioning the patient. But in the future it's going to be in the speed of the rotation of the image intensifier and detector, although I think that's going to have to be done under an IDE (investigational device exemption) with the FDA (U.S. Food and Drug Administration). The faster we can acquire the images, the fewer motion artifacts. It also may allow you to start measuring flow in vascular territories by looking at the speed in which they are being filled. So that's why the robotic component of the Artis zeego is pretty exciting. Right now we're really not using it to its maximal capability. A lot of these things are still under development.

How do the 3D imaging capabilities of *syngo* DynaCT improve your ability to treat patients in the hybrid suite?
I think it can improve accuracy. I'll give you an example of splenic and renal artery aneurysms. There was a patient recently whose CT scan I looked at in the office and it looked like this was a saccular aneurysm that was fairly easy to treat. When we did the 3D reconstruction and looked at it, there were actually several branches coming out of this aneurysm. It was marginal whether we should be treating it or not and we backed out of treating that patient because we thought the risk/benefit ratio was in favor of leaving it alone.

Tell me about the use of *syngo* DynaCT as a navigational aid.
With the catheter robotics that are currently available, we have highly accurate control and can move millimeter by millimeter when we need to. The first human cases have been done in relatively straightforward situations, the femoral artery, but the benefit really comes in some of the complex catheterization capabilities, so for example branched aortic endografts. One of the advantages perhaps of these robots is that when we've done the *syngo* DynaCT and we know the location of the renal artery is behind an endograft, where we can't inject it with dye directly, we can potentially with a robot puncture that endograft over the renal artery and then gain access to the renal artery. It adds a whole new conceptual capability in how we're going to manage those patients.

What are some advantages of combining 3D imaging with robotic catheter guidance?
Currently, when you take a catheter and navigate to the left coronary artery, you really don't navigate anything. You have a series of wall interactions between the catheter and the wall of the aorta all the way up – and that's where the complications come from. So centerline navigation is highly appealing. Can we get a catheter up there and never touch the wall or minimize wall contact? We may not be able to do it along the entire length, but in that critical terminal 10, 15 centimeters, can we build that capability? We can draw a centerline on *syngo* DynaCT, we can lay those lines on the patient so we can see a virtual line, and we're starting to have the ability to have that degree of accuracy in steering catheters. And those centerlines are just a series of points in space with coordinates – and robots follow directions pretty well.

What kind of training needs to be done for vascular surgeons to maximize the potential of 3D imaging?
When you see surgeons interacting with imaging equipment, it's not optimal. The radiation safety aspects basically are not there; the image optimization is often not where it should be. Those are gaps that we need to be teaching. I think there is an enormous imaging training opportunity, need actually, in the surgical world.

What do you see on the horizon for the future of imaging in surgery?
Right now, I think that you're beginning to see vascular surgeons using these tools and beginning to present and talk about them. But orthopedics, urology, general surgery, and thoracic surgery all have potential applications.

Sameh Fahmy, MS, is an award-winning freelance medical and technology journalist based in Athens, Georgia, U.S.

Contact
thomas.hartkens@siemens.com