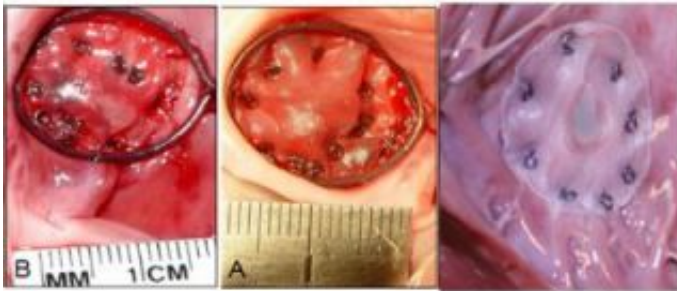


Video game technology may help surgeons operate on beating hearts

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When surgeons patched holes guided by ordinary 3-D ultrasound, they anchored their patches askew (left). Aided by stereoscopic vision (middle), they secured the patches with more evenly-spaced anchors (middle), results nearly as good as those with open-heart surgery (right). Credit: Images courtesy Nikolay Vasilyev, MD, Children's Hospital Boston

Surgery has been done inside some adults' hearts while the heart is still beating, avoiding the need to open the chest, stop the heart and put patients on cardiopulmonary bypass. But to perform intricate beating-heart operations in babies with congenital heart disease or do beating-heart complex repairs in adults, surgeons need fast, highly sophisticated real-time imaging that allows them to see depth. In an NIH-funded study featured on the cover of the June *Journal of Thoracic and Cardiovascular Surgery*, cardiac surgeons from Children's Hospital Boston report good results with a simple technology borrowed from the gaming industry: stereo glasses.

The researchers, led by Pedro del Nido, MD, and Nikolay Vasilyev, MD, of Children's department of cardiac surgery, had already been testing a three-dimensional ultrasound imaging system. But although the images are 3D and displayed in real time, they give little indication of depth. In animal tests, surgeons trying to navigate surgical tools inside the heart became disoriented when guided by these images.

Del Nido, chief of Cardiac Surgery at Children's, realized that what they needed was stereoscopic vision. Watching the flat picture on the computer screen was like watching a baseball game on TV, he says. "It's good enough to follow what's happening in the game, but you could never grab a ball in mid-flight," del Nido explains.

So collaborator Robert Howe, PhD, of Harvard University, plucked a solution from video games – splitting computer images in two and cocking them at slightly different angles. When wearing gamers' flickering glasses, users can see ultrasound images of the beating heart as a hologram. "You definitely have depth perception," says Vasilyev. "You feel like you're inside the heart chamber."

Vasilyev tested the glasses while operating on pigs with an atrial septal defect, a common form of congenital heart disease in which there is a hole in the wall dividing the heart's upper chambers. Vasilyev closed each defect using a catheter carrying a tiny patch, threaded into the heart through a vein. Using another device, he fastened the patch around the hole with tiny anchors. In all, he placed 64 anchors: 32 under standard 3D ultrasound guidance, and 32 using the stereoscopic vision display.

Using the stereoscopic display, Vasilyev was able to place the anchors 44 percent faster than with the standard display (9.7 versus 17.2 seconds). The tip of the anchoring device also navigated more accurately – deviation from the ideal path averaged 3.8 millimeters, as compared with 6.1 millimeters, a 38 percent improvement.

The accuracy of anchor placement didn't differ significantly between the two sets of tests, perhaps because of Vasilyev's high level of experience and the availability of tactile information to help guide the final step of driving in the anchors. However, the speed of the anchor placement improved significantly. The researchers believe that the ability to precisely navigate tools inside the beating heart will minimize risk to neighboring heart structures.

Clinical trials of beating-heart surgery with the patching system could begin in children with ASDs this year, Vasilyev says.

Del Nido believes that stereoscopic imaging – coupled with recent advances in catheter-based surgical tools – will eventually allow surgeons to do much more complex operations on beating hearts, such as closing more complicated holes, shaving away excess tissue or repairing fast-moving structures like mitral or aortic valve leaflets. "We look at some very unusual cardiac anatomy," he says. "Half the battle is figuring out what the structure is without opening up the heart."

For children, being able to do beating-heart surgery is a real advantage, del Nido adds. The large incisions can scar the heart and disrupt its rhythm, occasionally requiring a pacemaker. Opening the heart invites infection, and air bubbles can slip into the bloodstream and damage the brain. Running blood through a bypass machine can sometimes launch an inflammatory response, damaging organs throughout the body. And even in uncomplicated open-heart surgeries, recovery times are weeks to months.

Source: Children's Hospital Boston

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