Close Collaborations Advance Congenital Heart Disease Care

J. Paul Finn, MD
Professor of Radiology
Vice Chair of Innovative Technology
Chief of Diagnostic Cardiovascular Imaging
Department of Radiological Sciences
David Geffen School of Medicine at UCLA

UCLA offers comprehensive care to pediatric and adult congenital heart disease (CHD) patients, but that level of care would not be possible without a web of interdisciplinary collaborations that make clinical expertise in a range of specialties available to each CHD patient. "Congenital heart disease requires a focused effort on the part of caregivers in every clinical area," explains J. Paul Finn, MD, professor of radiology and chief of Diagnostic Cardiothoracic Imaging at UCLA. "Embracing clinical integration in all our treatment pathways is very important."

The first-line imaging study for congenital heart disease patients at UCLA is usually an echocardiogram, which is performed by a cardiologist. Because of the complexity and wide variation in anatomy among congenital heart disease patients, these are highly specialized echocardiologists who see only congenital heart disease patients.

When advanced imaging is needed, UCLA radiologists contribute their imaging expertise. "We need to work closely with our colleagues in cardiology and cardiac surgery to know what we need to focus on and what questions we have to address through our MRI and CT studies," states Dr. Finn. Their findings are shared at multidisciplinary clinical conferences held twice a week.

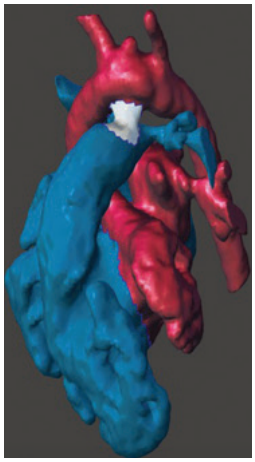
Sharing Study Results

Presenting advanced imaging studies at their clinical conferences to illustrate cases for discussion is very important to effective collaboration. UCLA radiologists make use of digital viewers that support the DICOM (Digital Imaging and Communications in Medicine) standard to more effectively share their findings. "While an imaging study report includes the essential information from the study, it sometimes doesn't convey the full visual picture that we can communicate when we show the actual study images to the surgeons and cardiologists," Dr. Finn explains.

Among the DICOM viewers that UCLA uses is one that was developed by a UCLA radiologist that has grown to become one of the leading DICOM viewers and image processing platforms. "We've followed a path of developing or inventing new ways to do MRI studies, but we have to convey the findings to our surgeons and cardiologists in a useful way and in a timeframe that has clinical relevance," explains Dr. Finn. "For that, we had to get a bit creative about developing tools and resources."

3D Printing and Virtual Reality Puts Imaging Data in Surgeons' Hands

Because we are recognized as a leading center for congenital heart disease, complex cases with very abnormally developed anatomy are often referred for treatment to UCLA. Here, our pediatric cardiac surgeons (Glen Van Arsdell, MD, Hillel Laks, MD, and Reshma Biniwale, MD) may have to determine if it is possible, for example, to perform a bi-ventricular repair — so the patient will have a more normal heart anatomy with two pumping chambers — or if the repair will have to rely on a single ventricle to perform the work of two chambers. Bi-ventricular repairs are preferred for offering better long-term outcomes and quality of life, but can it can be very difficult for surgeons to determine the optimal surgical plan of such repairs — or even their feasibility — based on imaging alone.



4D MUSIC MR image in a newborn baby is used to create a virtual model of a surgical procedure whereby a communication (white) is created between the aorta (red) and the pulmonary artery.

3D printing has promise to greatly aid surgical planning by presenting a detailed physical model of the existing anatomy of these sometimes tiny hearts. But outsourcing 3D printing was proving to be time- and resource-intensive when care demanded prompt decision making.

"4D MUSIC — Multiphase Steady State Imaging with Contrast — using ferumoxytol can generate very detailed images of all the chambers and blood vessels in the heart, even in small hearts with very rapid heart rates" states Dr. Finn. "The question is how do we quickly and effectively turn these into printed models for our surgeons." Gregory S. Perens, MD, professor, Division of Pediatric Cardiology, began experimenting with a relatively inexpensive 3D printer and was able to generate several very useful 3D models. Takegawa Yoshida, MD, a research associate in the Department of Radiology collaborates with Dr. Perens to convert the 4D MUSIC image data to a file format supported by the 3D printer.

This technological collaboration between cardiology and radiology to produce 3D printed models quickly and inexpensively has facilitated clinical collaborations by enabling radiologists to more effectively share anatomical data with surgeons. UCLA physicians continue to work together to further develop this technology and gain more insight into how it can be used to determine if various types of surgical reconstruction will be appropriate and successful.

Furthermore, as Virtual Reality hardware and software become increasingly available, the anatomy of the 3D beating heart can be visualized even without physical models. These tools will add a new dimension to our ability to convey relevant information for surgical planning.