Advanced technology in the cath lab: CT, VR, robots, and 3D printing

Precision medicine or “personalized medicine” is poised to become a cornerstone of future medical diagnostics and therapies. The idea is to use a patient’s own information to create treatments that are tailored to them specifically. This type of specific evaluation and treatment may reduce cost, increase effectiveness, and improve safety.

The cardiac cath lab (aka “cath lab), is the place where a patient is treated for blockages in the heart arteries. Sometimes this is for chest pain, and sometimes this is for heart attacks. Four specific technologies may help personalize medicine in the cardiac cath lab: noninvasive CT coronary angiography, virtual reality, robotics, and 3D printing.

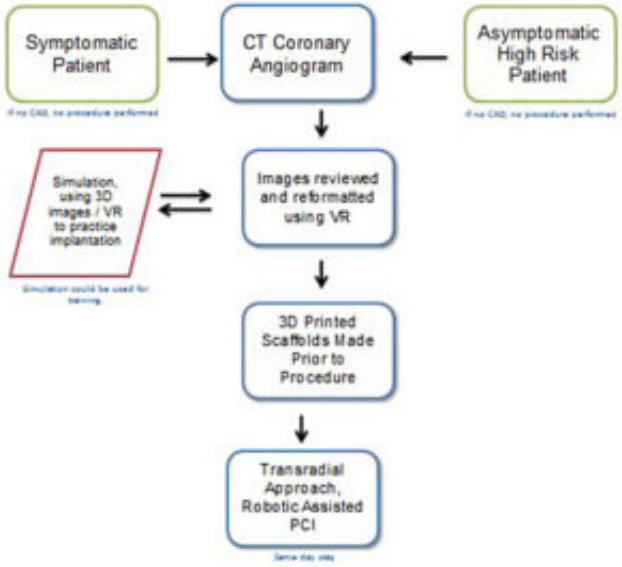

Fig. 1. Diagram of how the flow of patients would occur: Patients would be evaluated for chest pain, then (only if they had blockages) would they be sent for invasive procedures. Once there, the data obtained with the CT scanners would be used to accurately place stents which were created (using 3D printing) for that specific patient.

CT scans can image every part of the human body non-invasively, and that goes for the heart too. Now with ultra-fast CT scanners, even the beating heart (including the coronary arteries) can be looked at without anything being put in the body. This allows doctors to evaluate patients who have chest pain for the presence of blockages, and that way only those patients who *really need* to have an invasive procedure will get one. In addition, it will allow doctors to understand exactly the location and type of blockages a person might have before catheters are ever put in their body.

Virtual reality is a relatively new technology that allows a person to have a first-person, immersive perspective of information and data which is either entirely, or partially created by computers. Merging real information with virtual information will increase physicians' ability to precisely evaluate a patient's data prior to and during their actual catheterization, allowing for greater understanding of a patient's issues at the time of their procedure.

When a patient has a blockage in their heart arteries, doctors use very small tubes called catheters (usually put inside the patients through their wrists or leg arteries) and open the arteries of the heart using balloons and stents which are put through these tubes. Robots, connected to these catheters will allow the doctors to more accurately place the balloons and stents, and allow this to be done with less radiation exposure.

Finally, the stents which are used today to open arteries are not made for that person in particular. Pre-made choices of size (both length and width) are used. If a patient has a very long blockage, sometimes 2 or 3 stents are used to open it. Everyone has arteries which are shaped differently, and blockages are similar but are never exactly the same. Using new 3D printers, doctors should be able to print stents which are sized specifically to that patient's heart. This could allow for fewer stents to be used, or at the very least use stents which fit more exactly.

Some of these technologies (such as CT angiography and robotics) are being used today in clinical practice, but these four technologies are not yet being used together. Our hope is that as these technologies are used more frequently, and used together, it can improve safety for the patients and doctors, reduce cost, and improve the entire healthcare experience.

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