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GAYATRI ACHARYA: Greetings. I'm Dr. Gayatri Acharya, Cardiology Fellow at Mayo Clinic. Today, we will be discussing virtual reality and the role it plays in medicine. I'm joined by my colleague, Dr. Suraj Kapa, who specializes in this area. Welcome, Dr. Kapa.

SURAJ KAPA: Thank you, Doctor.

GAYATRI ACHARYA: It's great to have you here. Today, we're going to be talking about virtual reality, so can you tell us, what is augmented and virtual reality?

SURAJ KAPA: That's a great question. People traditionally think of virtual reality as these really expensive, bulky goggles you put on that allow you to be in an immersive environment and, thereby, play video games, or do other things that you see on television.

But the truth of the matter is these technologies have been around since the 1950s and 1960s, with people wanting to find ways of using machines to overlay data on their environments, or to be able to interact with data better. And nowadays, when we think of augmented reality and virtual reality, it's really a continuum. Augmented reality is a way where you can still perceive the general world around you, but perhaps use an iPhone, like with Pokemon Go, and project data into the entire surrounding environment. We still see the environments, but you have additional data within it.

Or glasses that we can wear, ranging from Google Glass, all the way through more expensive glasses that allow you to actually use the power of a computer to project additional information. I could be sitting here looking at you and seeing a CT scan of your brain projected onto your body in real time and actually interact with it and understand how it's moving with your body and everything else. Or I can pull up vital signs monitors around you to see exactly what your vitals are without actually having to pull up a computer. So it allows me to interact with you and your data more directly.

Virtual reality takes that a step further, where rather than having data portrayed into the surrounding environment, it actually puts you in entirely different immersive environments It's like walking into the hospital which you're going to have your surgery in beforehand and being able to see everything, even if you had never been there before. And this is kind of the range of what we think about when we think of everything from augmented to virtual reality.

GAYATRI ACHARYA: So it sounds like this is something we're considering applying in the health care field. How do you see this being applied to medicine and how we practice?

SURAJ KAPA: Great question. So the truth is, it's already being applied. If you look at work from a number of groups, they've looked at virtual reality, these immersive environments, as ways of improving depression, as ways of improving anxiety, of reducing opioid needs for pain control. And actually, reducing anesthesia needs for areas where you need moderate sedation or even more deep sedation.

And they've shown that putting some of these immersive environments can actually help all of these situations. I'll give you one great example of a friend of ours who has severe Alzheimer's. And her family brought her in, and we put her in a map environments and took her to where she was born and all the places she lived. And it was fascinating, because she was able to relay every single place she would go to school, where she met her husband, where her parents first picked her up after a dance recital. And she was able to relay all of this. And for a brief period of time and throughout that time and afterwards, she was completely lucid.

So in many ways, it's already being applied. But if you really look at the silos within which we can really advance this, there's the area of simulation and education, which is probably the one that's the most obvious, because you can take entire operative environments and project this into virtual reality and allow any number of students, anywhere in the world, to be watching that surgery, either in real time or afterwards to understand, how were the surgeon's hands moving?

We've all encountered this. We're medical students, and we're fourth down the line on the bed trying to see what exactly the surgeon is doing, and they're moving their hands around, but we have no idea what they're actually touching. What if we could stand in the surgeon's position and actually look directly down and see exactly what they're doing, what they're touching, how their hands are moving.

And this is one area where it's actually already being done. There is a group in London that have actually been transmitting their surgeries in real time to hundreds of thousands of students worldwide, allowing them to get that exposure no matter where they are, no matter what their medical school does, or where it's located. So we can advance education.

Simulation, like we talked about before, being able to walk into an environment that you might need to work within, but right now the only way to know about it is to be there. But what if you can actually be there beforehand? So that's one silo.

A second silo is that of data integration. Within medicine, especially procedural characteristics, we get all of this data beforehand-- we get imaging tests, we get vital tests, we get electric cardiographic monitors within my field. And we look at all of that beforehand. And then we throw it all away, we walk into the lab or into the OR, we throw on our sterile scrubs, and then we just have to remember what we looked at. Wouldn't it be so much better if we could pull that up in that environment, still stay sterile, but yet still interact with that data and see how it's integrating with what we're seeing in front of us in real time?

And then the third silo, which I think is probably the most important or potential one, is how do we educate our patients better, and how do we integrate them into the space of their own clinical care? How do we take care of them at home, provide them with physical rehabilitation leveraged through virtual avatars of physical therapists, where they can train them through the exercises they need to do without having to find a rehab center when they're located in a location that's hundreds of miles away from the nearest hospital? These are three big areas within which, at least I see, these technologies evolving.

GAYATRI ACHARYA: And these all sound great, but how far away from this technology are we? And how are we going to implement this at Mayo Clinic?

SURAJ KAPA: So we are getting there, but we also have a ways to go. Because we are evolving as the technology evolves. So where we stand right now is, we're already taking and having a pipeline built for having every CAT scan, every MRI scan, automatically pipelined into a 3D compilation system that can immediately segment that data into a three-dimensional image that we can work within, cut through any which way we want within an immersive 3D environment.

So we can understand the complex congenital heart, how things relate to each other. We're working in the area of lead extraction to say, where are the areas that the lead is actually [INAUDIBLE] bigger to tissue? Because we can alter the parameters of the tissue density much more than we can in a standard two-dimensional CT that we watch on a computer screen.

In addition to that, we're working to digitize every procedure room that we have in the hospital. And the people who are going to be training within it, working within, et cetera, can work with the actual equipment in that room before they ever walk into it. So they can understand it. So they can understand, for example, radiation safety, for that specific fluoroscopic machine that they're going to be using.

The third way is-- and this is both futuristic thinking as well as now thinking-- is integrating cameras into our operating rooms, where we'll be able to capture all the three-dimensional data of what's happening in the operating room. And if you think about it this way, one of the biggest discoveries or developments in medicine, in modern medicine, was the surgical checklist. The impact that had on safety, on outcomes, was huge.

But we still need people actually writing all the things down, checking off all the boxes. They have to have their eyes everywhere. But what if we can do that by creating a three-dimensional reconstructed environment that then allows a computer to automatically check everything off, that allows it to be more accurate, and more real-time with reduced number of resources.

And these are some areas where we're already working. But the eventual paradigm which we're working on is, as these devices become more miniaturized, implementing them into our medical school, implementing them into our daily practice, implementing them into how we work with our patients, from the time they walk into the waiting area, through the time they actually come into your office and are sitting there waiting wondering what you're going to say ahead of time.

So those areas are big areas we're working already. But there's a vast area of potential that might evolve as we get different devices, newer devices, or more evolved devices.

GAYATRI ACHARYA: You think those are things that we'll start to recognize as we start to use the technology? Things that come up over time? And I know as a trainee, it would have been extremely helpful to have some familiarity with the environments you're walking into, or even just have a more advanced visual aid that specifically addresses the patient's anatomy, instead of my kind of crude drawings that may not fully be applicable to the patient, or maybe they don't fully understand. What other areas do you see this-- us being able to use this technology in medicine?

SURAJ KAPA: So other areas where we might be able to use this technology are to advance our relationships, not just within the clinic with the people we're working with, with the data they're working with, but when you think about how the Mayo Clinic first started, the Mayo brothers weren't just about creating the best hospital within the cornfields of Minnesota. Their paradigm was one of travel and bringing information together, of both teaching others, as well as bringing what others can teach them back.

And this holistic principle that underlay them traveling and having a ship that ran up and down the Mississippi to deliver care never accounted for these vast computational technologies that might allow us to talk to somebody who's doing a surgery on the other side of the world, and actually be in their OR telling them what they might be able to do differently. Or being able to log into a patient's room in a different state, or in a rural area, and being able to tell them, hey, I can listen to you, and I can talk to you face to face, and you don't have to fly, and you don't have to travel.

These technologies will allow democratization of medical access, and I see that as really being the future of these devices being integrated into a practice.

GAYATRI ACHARYA: It's all very exciting, and I can't wait to see where we take this technology. Thanks, Dr. Kapa, for these very important insights, and thank you for joining us on theheart.org on Medscape Cardiology.