Fake Worlds Offer Real Medicine

Virtual Reality Finding a Role in Treatment and Training

Paul D. Thacker

ONE SEPTEMBER DAY IN 1999, AS Stephanie Wall traveled down a Colorado highway to begin her freshman year at a university in Denver, her life took a dramatic detour. A passing car swerved into her lane, forcing her off the freeway. Her SUV rolled over, leaving Wall with severe injuries.

Two months later, upon release from the intensive care unit of a Denver hospital, she returned home to San Diego to begin the painful process of physical rehabilitation and multiple surgeries. Her body was on the way to recovery, but she was now terrified to drive.

"I would be in the car with Mom and would get really anxious, sweating, and I would jump," she says. "I would even shut my eyes sometimes when I saw a car coming at me in the same sort of way as [in] the accident."

Two years later she ended up at the office of Brenda Weiderhold, PhD, a professor of psychiatry at the University of California, San Diego. Weiderhold runs the Virtual Reality Medical Center, the world's largest clinical practice devoted to virtual reality (VR) as a tool for treating psychiatric disorders. With the increasing processing power of computers, VR is finding a niche in medicine—not just for treating patients, but also in training medical staff to perform complex procedures and to work in teams.

SIMULATED WORLD, REAL FEARS

Virtual reality's role in treating patients is probably most established as a therapeutic tool for defusing phobias through exposure therapy. This approach provides a controlled and safe environment in which patients are exposed to anxiety-producing stimuli, while signs of anxiety such as heart rate, respiration, and sweating are monitored.

Wall, for example, began multiple sessions of exposure therapy while in a driving simulator. As her anxiety decreased after exposure to low-intensity stimuli, such as driving on surface streets, she was gradually introduced to more challenging events, such as motoring down a freeway with no traffic.

"It was obviously a computerized environment," said Wall, who now tackles Southern California's freeways. "But still, it felt real. The drivers would even yell at me, sometimes in Spanish, and one time I started yelling back."

Weiderhold, who has treated hundreds of patients with VR exposure, says the technology fools the body into behaving as if the experience is real. With auditory, visual, and tactile input, "it allows all the senses to be stimulated," she said. "It's a powerful experience that we can control slowly and systematically at [each patient's] pace."

Barbara Rothbaum, PhD, of Emory University, Atlanta, first demonstrated that VR could treat psychiatric disorders in a 1995 study of patients with fear of heights (*Am J Psychiatry*. 1995;152:626-628). Rothbaum, who specializes in treating anxiety disorders, said that controlled studies show VR offers therapy that is as effective as traditional exposure models without many of the logistical obstacles and expenses. Such hassles and expenses, for example, have precluded many therapists from offering conventional exposure therapy to patients with a fear of flying.

"I had to spend all this time in traffic getting to the airport, arrange with

The Virtual Reality Medical Center

Some therapists are using virtual reality as a tool to treat phobias, such as a fear of driving, by providing a controlled simulation of anxiety-producing stimuli. As patients' anxiety decreases after exposure to low-intensity stimuli, they are gradually introduced to more challenging conditions.

a redcap to get on a stationary plane—hours and hours my patient is paying for, and we haven't even taken a flight," said Rothbaum. In 1996, Rothbaum and computer scientist Larry F. Hodges, PhD, of Georgia Institute of Technology cofounded a company, Virtually Better (http://www.virtuallybetter.com), that develops and markets VR hardware and software programs to clinicians to treat fear of flying and other problems, including fear of public speaking, claustrophobia, and panic disorder. Now, with VR, the patient can easily experience multiple takeoffs within a therapeutic session of 45 minutes. Rothbaum's controlled studies have shown that up to 90% of patients going through VR therapy fly within 6 months, a success rate equivalent to that of traditional exposure therapy on an actual plane.

University of California, Davis, School of Medicine

Cardiologist Reginald Low, MD, of the University of California, Davis School of Medicine, uses a patient simulation system that allows medical staff to practice difficult interventional procedures, such as the treatment of a "patient" with an acute heart attack.

NEW DEVELOPMENTS

Rothbaum points out that new possibilities are being explored. With a grant from the National Institute of Drug Abuse, she is creating a "virtual crack house" to treat drug addiction and to test pharmaceuticals developed to treat substance abuse. "If you have a new compound that is supposed to reduce craving, you can't just give it to an addict and turn them loose," said Rothbaum. "But you can expose them to many of the same cues, such as a [simulated] crack house, and see if they have a lesser reaction."

Other investigators are exploring the use of VR for a range of conditions. Hunter Hoffman, PhD, of the Human Interface Technology Laboratory at the University of Washington, Seattle, has explored VR as a type of pain distraction, much like yoga or hypnotism. Giuseppe Riva, PhD, of the Catholic University (Milan, Italy), recently finished a study with 500 participants that found VR can augment obesity therapy by changing a patient's body imagery and by teaching coping behaviors around food (*Cyberpsychol Behav*. 2003; 6:251-258). And at the University of Georgia, in Athens, Patrick Bordnick, PhD, has just begun a study of the use of VR in smoking cessation, to help patients recognize cues that trigger a desire to smoke and to help them develop coping skills to resist.

"I've had people try to reach for packs of virtual cigarettes," said Bordnick.

Weiderhold said that use of VR as a therapeutic tool is still confined mostly to university practitioners and researchers. "Even though it has been used for 10 years to treat phobias, this therapy is still in its infancy," she said.

But as costs for systems decline and the next generation of therapists become acquainted with the technology, it will become more common. Today, hardware can be bought for around $15000, and Virtually Better has a licensing program that offers nine software packages for a monthly fee.

BOOTING UP THE "PATIENT"

Invasive procedures are complex, skill-intensive activities, requiring a great deal of practice and coaching from mentors, such as David Dawson, MD, of the University of California, Davis School of Medicine and Medical Center.

"You want to go slowly as you feed the catheter up the vein so that you don't perforate the vessel," Dawson told a nervous neophyte during a procedure at the university hospital, threading a catheter up an artery of a middle-aged male with an occluded vessel. After performing the angioplasty and setting a stent, the procedure was declared a success, and the "patient," Simantha, was switched off.

Simantha is a mannequin placed on an actual operating platform along with the computer screens and other surgical hardware actually deployed in angioplasty and other coronary procedures. It is perhaps the most advanced surgical simulator in existence, providing the operator with tactile feedback by enabling them to feel the catheter as it moves up the vessels.

Before coming to Davis, Dawson was chief of the medical sciences division at the National Aeronautics and Space Administration (NASA), where he learned the power of simulators in training. "Both in aviation and medicine, we can look at components of learning skills," he said. "It makes so much sense, and we know that people in aviation who train on simulators go on to do well in the real world."

Skills enhancement is important, but physicians also need to learn how to deal with uncommon adverse events where it is essential to know what to do but difficult to prepare for, precisely because such events occur infrequently.

"We're trying to move the learning curve for complex procedures, but we also need to able to handle situations when things go wrong," said John Carrol, of University of Colorado Health Sciences Center, in Denver. "If you do 1000 cardiac interventions you might perforate a cardiac artery once or twice—but when it happens, you have to be instantly familiar with how to handle it. There's too much at stake for hesitation."

USE IN CERTIFICATION?

The medical community is currently analyzing the role of simulators in a number of arenas. The American Board of Internal Medicine, for example, is examining the use of simulators to assess skills and may include them as part of its general certification process.

At the US military's National Capital Area Medical Simulation Center (http://simcen.usuhs.mil/), surgeons train in both virtual environments and on simulators. "The difference is that virtual reality uses an environment where all the information is stored in a computer," explained surgeon Richard M. Satava, MD, of the University of Washington, Seattle. "With simulators you have something tangible you can touch, like a mannequin."

The center is also the first site where surgeons can be certified in the Advanced Trauma Lifesaving course without the use of animals, relying solely on simulators. Satava predicts that in future years, VR will play a larger role of the licensing and certification process in medicine, making it easier to assess skills in a standardized manner.

But Michael Wilkes, MD, PhD, vice dean for medical education at University of California, Davis, School of Medicine, worries that as simulators become more a part of the medicine, costly technology will only create more disparities in health care.

"These technologies are extremely expensive and could become concentrated at the wealthy hospitals," he said. "Let's ensure that doctors in all communities get the same level of training." □

Studies Explore Impact of New Pathogens

Investigators Report on Metapneumovirus, SARS

Joan Stephenson, PhD

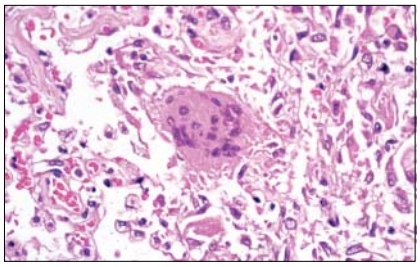
CHICAGO—A virus identified just 2 years ago may be a leading cause of serious respiratory tract infections in young children, according to new findings by several groups of investigators.

In studies presented here at the Interscience Conference on Antimicrobial Agents and Chemotherapy, researchers found that human metapneumovirus (MPV), a respiratory virus discovered in 2001 by scientists in the Netherlands, may be responsible for the hospitalization of thousands of infants every year and the source of many colds in adults.

Researchers at Vanderbilt University tested 687 archived nasal specimens collected from children younger than 5 years with respiratory tract infections. Laboratory tests revealed that about 12% of the samples were positive for MPV—second only to respiratory syncytial virus,(RSV), which accounted for about half the infections, reported James F. Crowe, Jr, MD.

HIDDEN IN PLAIN SIGHT

Although MPV was recognized only recently, the microbe has been around for at least a few decades, but was previously undetected because it doesn't grow well with typical cell culture techniques. The Netherlands researchers have found evidence of the virus in serum samples collected in 1953, and the Vanderbilt group discovered MPV in sera collected in the late 1970s, said Crowe.



CDC

This photomicrograph reveals pathological changes in lung tissue in a patient with severe acute respiratory syndrome (SARS).

Other studies presented by researchers outside the United States confirm the wide-ranging scope of MPV infection. Researchers at Laval University in Sainte-Foy, Quebec, found that 5.5% of more than 450 children with severe respiratory tract infections tested positive for MPV; about half had RSV and nearly 13% had influenza virus infections. Another study, by investigators at Hadassah University Hospital in Jerusalem, found that one third of children had been exposed to MPV by their first birthday; by age 2 years, more than half had been infected.

Although MPV is extremely common, most people with MPV infections do not develop severe illnesses. The infection is most likely to threaten the very young or the elderly, explained Ann R. Falsey, MD, of the University of Rochester Medical School.

"We are trying to figure out if MPV in adults is a big deal," she said. Falsey and colleagues found that MPV may account for 10% of hospitalizations of elderly patients with respiratory tract infections.

Researchers have also found that many patients with MPV are coinfected with another respiratory virus, making it difficult to sort out the virus's role in illness. Some investigators suggest that in infants with RSV, coinfection with MPV may influence the severity of bronchiolitis (*Emerg Infect Dis*. 2003;9:372-375). Another recent study published in the September issue of *Emerging Infectious Diseases* found that half of 48 patients with severe acute respiratory syndrome (SARS) tested in last spring's epidemic in Hong Kong were also infected with MPV (http://www.cdc.gov/ncidod/EID/vol9no9/03-0304.htm), but whether the latter plays a role in the syndrome is unknown.