Tiny bubbles... Huge Impact

By Bill O'Neill

UNMC cardiologist studies microbubbles' use in heart diagnosis, drug delivery

If it weren't for the research seed money that Tom Porter, M.D., received from UNMC in the mid-1990s, he's not sure where his promising research on microbubbles might be.

For certain, an NIH-funded, Phase I clinical trial looking at the promise of microbubbles in drug delivery wouldn't have been possible, but that study is currently taking place at UNMC.

And, without the initial seed money, it's unlikely that scientists in 14 sites worldwide would be utilizing microbubbles in helping physicians study the hearts of patients undergoing stress tests.

"I'm very thankful that the seed money allowed us to make a contribution in the cardiac care of patients," said Dr. Porter, a professor of medicine in cardiology at UNMC. "And, we're still trying to learn more."

A decade ago, uncertainties were abundant regarding microbubbles' applications. Scientists doubted that the microbubbles, then filled with room-air gases, could reach the left side of the heart following an intravenous (IV) injection. The scientists needed the bubbles to get to that location to use them to study blood flow into the heart.

Dr. Porter and his collaborative investigators thought that microbubbles could be altered to be usable in cardiac testing.

"The seed grant from UNMC allowed us to determine that if we changed the gas inside the microbubbles, they would reach the left side of the heart," Dr. Porter said.

Initially, the testing, which took place on dogs, wasn't too successful. During their experiments, though, Dr. Porter and his research group noticed that a bright light – almost like a starburst – would appear in the heart muscle immediately after the researchers turned the ultrasound transducer on to the image of the heart. Eventually, they determined that their microbubbles were surviving until they were "hit" with the ultrasound. When this occurred, tremendous energy was given off, producing the contrast.

"Before this study, we hadn't realized how much ultrasound was destroying the microbubbles," Dr. Porter said.

What came about were two major medical advances: 1) By turning down the ultrasound power or delivering it intermittently, the UNMC-patented microbubbles could remain intact and could be used to study the blood flow into the heart; and 2) that the microbubbles could be used for drug delivery. Researchers are studying ways in which drugs can be attached to microbubbles, delivered to a specific location, and then released in that area when ultrasound causes the bubbles to "bounce," knocking the drugs off of the microbubbles.

"It really changed the way that everyone has viewed ultrasound," Dr. Porter said. "That destruction process can be used beneficially. It's still in its development, but this is a very promising, non-invasive technique."

Dr. Porter said that another way in which the ultrasound technique will be studied is therapeutically, where the energy produced by ultrasound and microbubbles will break up clots that occur in clogged arteries. Scientists think that the destruction of microbubbles by ultrasound may erode the blood clot and restore flow in the blocked arteries.

For sure, using microbubbles in addition to the traditional echocardiogram will be further researched. An echocardiogram uses ultrasound to show physicians the thickness of the heart walls and to detect damage and disease. However, the test doesn't show blood flow to the heart very well. Preliminary research indicates that the microbubbles can help physicians find these blood flow abnormalities that currently only the more expensive nuclear imaging would be able to detect.