An Unexpected Encounter

Back in the 1980s, a bright young graduate student completed her PhD dissertation on MRI brain diffusion imaging at the Massachusetts Institute of Technology. Little did she know that cutting-edge technology would someday save her life.

By Diana Smith

"I was trained as a scientist and have always been interested in health and technology," says the scientist, who wishes to remain anonymous. "I became very interested in MRI [magnetic resonance imaging] in my first year of graduate school. My doctoral thesis was on MR diffusion imaging, and I continued working on MRI abroad for my post-doctorate research."

A passionate scientist, she continued work in the field and built an impressive global resume. Since 2006, she has been doing research collaboration with a leading hospital in Asia, performing a clinical research study on breast imaging to compare breast MRI and breast diffusion imaging with conventional techniques such as mammography and ultrasound.

New Imaging Techniques

In the blink of an eye, a speck on a mammogram or an aberrant lump felt in the shower can change a woman's life. Breast cancer is by far the most common cancer among women.[1] The numbers have been increasing worldwide, rising rapidly, particularly in younger women. According to the American Cancer Society, in 2008, 1.3 million cases will be identified, and almost 500,000 women will die from the disease. In the U.S., breast cancer will be diagnosed in one in eight women. Though rare, men can also get breast cancer.

New imaging techniques are helping doctors diagnose tumors with greater precision and less trauma. Mammograms can be less effective in women with dense tissue which makes the images harder to read. Magnetic resonance imaging has been shown to find breast

[1] http://www.who.int/cancer/detection/breastcancer/en/. Last accessed Nov. 4th, 2008

The scientist's breast cancer was discovered by chance.

"Women need to know what they should look for in getting the best diagnostic examination."

cancers that mammograms miss in a certain group of patients.[2] A study published by the Scientific Assembly of the Radiological Society of North America (RSNA) reported that the detection rate for nonpalpable, invasive breast cancers increased by 42 percent in women with dense breasts when mammography was followed by ultrasound.[3]

"Taking the technology to a new level," the scientist explains, "diffusion is looking at the water mobility, the movement of water molecules in tissue. We thought this technique would be very sensitive in finding abnormalities in the breast, and it's perfect when you have a group of patients who have proven biopsies, because then you have histologic comparison. We have the exact pathological specimen to compare with what we see in imaging."

In a clinical study in Hong Kong, 31 female patients with suspected breast lesions underwent diffusion imaging and dynamic contrast-enhanced MRI[4] using a 3 Tesla scanner (Siemens MAGNETOM® Trio, A Tim® system). The clinical research study was performed in Asia, where, increasingly younger women are being affected by breast cancer. Younger women tend to have denser (leaner) breast tissue. Dense breast tissue can present special difficulties for disease detection. In mammography, dense breast tissue and tumors both appear white. "It's like finding a polar bear in a snowstorm," says the scientist.

Accidental Discovery

A chance discovery changed everything, recalls the scientist. "The clinical results from the patient study were really good. Out of curiosity, I went in the scanner for this diffusion technique. No contrast injection was needed with diffusion imaging. It was quick and easy, and I was out of the scanner in five minutes. As I came out, I saw the stricken face of the radiologist and knew something was wrong."

Since the diffusion technique was new and is not yet routine for breast imaging, the radiologist in charge recommended a follow-up with a complete examination and conventional diagnostic methods. These included digital mammography, ultrasound, contrast-enhanced MRI[4], and lymph-node mapping.

Not the Right Destiny

At only age 45, the researcher was in a low-risk group with no family history of the disease. Previous mammograms and ultrasounds were normal. A nonsmoker, she was slim and followed a healthy diet. "I was shocked," she says. "I couldn't believe it. I always thought I have been healthy and active."

The hours that followed were a roller coaster of emotions, particularly since she was thousands of miles from home and loved ones. "The worst was the moment when you are told you have

[2] Efficacy of MRI and Mammography for Breast-Cancer Screening in Women with a Familial or Genetic Predisposition. *N Engl J Med*, Vol. 351, No. 5:427-437

[3] Mammographic Density and the Risk and Detection of Breast Cancer. *N Engl J Med,* Vol. 356, No. 5:227-263

[4] Not available in the U.S.

"It's so important to create and offer well-planned radiology departments coupled with women's health centers to minimize anxiety and suffering after someone is diagnosed with breast cancer."

cancer," she explains. "It feels like you just got a death sentence." That evening, the radiologist in charge, who is also a caring friend, took the scientist to dinner and "turned a potentially sad evening alone after a shocking diagnosis into one that made me think more about friendship, people who care, and the life ahead."

A Personal Decision

Because of her background in medical imaging, the scientist was more informed than most about the diagnostic tools and treatments used in breast cancer. Like American actress Christina Applegate, who elected to have a mastectomy in the summer of 2008 at age 36 to eliminate constant fear and onerous exams every few months, the scientist opted for immediate surgery.

"I know of women who had lumpectomies followed by radiation and chemotherapy, and their cancer reoccurred," she says. "Every woman is different. I made my personal decision to have a mastectomy to have peace of mind and reduce the risks of recurrence to almost zero."

Recovery

"The first couple of weeks were very hard," remembers the scientist. "I've never had any kind of surgery before, and of course, you cannot bathe or even put on clothing yourself. You are very dependent on someone to help you."

She adds, "In a way, I was very lucky that it [finding the cancer] happened where I knew the clinicians. Though I was very far from home when this happened, I was in a well-known hospital with state-of-the-art equipment. I found the hospital to be well organized with women's health and radiology all under the same roof. Everything was very conveniently located in the same building and I could get all the tests done within the first 48 hours."

"I understand many women are less fortunate and they are sent to different places and have to wait weeks before getting all the tests done. The waiting can be bewildering. Some hospitals are still not prepared to offer a streamlined process for people affected with such a diagnosis. Sometimes, the hospital may not have the right imaging equipment or the latest software. It's easy for a patient to be sent to get multiple tests, get lost in the medical maze, and spend endless hours and days waiting for the results. It's so important to create and offer well-planned radiology departments coupled with women's health centers to minimize anxiety and suffering after someone is diagnosed with breast cancer."

Speaking Out

Today, the scientist is still consulting and she is using her experience to be an advocate and speak to others about the disease and the imaging modalities used to diagnose and treat it.

"I've learned a lot through this process. I now teach women about early detection and how it helps to save lives. It's also important to know about the possibilities in detection and treatment," she emphasizes.

"Most people know someone who has had breast cancer. Most people know of mammography and breast ultrasound. Some know about breast MRI, but they don't really know enough details, for example, whether their hospital has the state-of-the-art scanner with the latest software or whether it is using a scanner that is ten years old, which does not offer the best resolution or the same functionalities as the newer ones. Women need to know what they should look for in getting the best diagnostic examination and what they should ask their healthcare providers. When patients are well-informed, they have the best chance for survival and can live a long and healthy life."

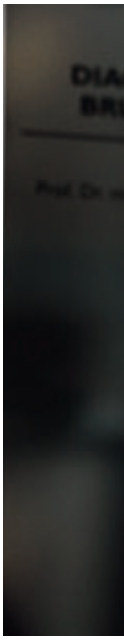
An Enlightened Path

"I'm back to my previous activities and actually feel better than before," says the scientist. "When you go through an experience like this, you get to see who really cares about you and who loves you for who you are. I have a stronger appreciation for people who show kindness despite work pressure and busy schedules. I particularly remember a late-shift nurse and her words of kindness and encouragement when she came to do an IV [infusion] around midnight. When you are flat on your back in a hospital bed, you have time to think, to ponder, and to feel."

She concludes, "I have come from this experience with a greater appreciation for life. I'm grateful for the early detection that helped save my life, and I have certainly grown from the enlightenment and reflections during this unexpected journey."

A Worldwide Challenge

Diverse imaging solutions and advanced, integrated technology are providing a new level of care for breast cancer patients. For a global view, *Medical Solutions* interviewed three imaging experts around the world:



Gladys Lo, MD, Chief Radiologist, Department of Diagnostic and Interventional Radiology, Hong Kong Sanatorium and Hospital, Hong Kong, China

John F. Nelson, MD, Medical Director, Battlefield Imaging, Battlefield Auxiliary Breast Center, Ringgold, Georgia, U.S.

Karsten Ridder, MD, Radiological Group Practice, Outpatient Clinic Professor Dr. Uhlenbrock and Partners, Diagnostic Breast Center, St. Josefs-Hospital, Dortmund-Hoerde, Germany

Thank you for finding time to talk to us across many time zones. All of you provide state-of-the-art breast cancer care with integrated imaging systems from Siemens that optimize clinical, operational, and financial workflow. Let's discuss how diagnosis and treatment of breast cancer has changed since you started in the field.
NELSON: I have been practicing for about 20 years, so I've seen quite a few changes. Technologically, we've obviously seen huge strides in screening mammography just in the ability to see and pick up lesions. In recent years, most of us in the U.S. and across the world have probably transitioned to digital mammography. I think probably everyone on this panel would agree the improved screenings have saved lives. So, that has really changed the way I practice. Secondly, of course, the different modalities we use to evaluate patients diagnosed with suspected breast cancer also have ballooned. Ultrasound is no longer something that we do occasionally – it's something we do all the time. Additionally, advanced techniques like breast MRI [magnetic resonance imaging] have revolutionized what I do as a diagnostician.

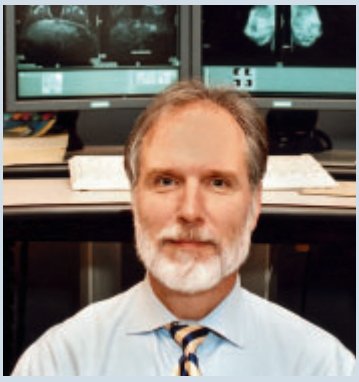
RIDDER: Changing from analog to digital mammography is like the invention of rubber for the wheel. It is much faster and more precise than before, especially when you are looking at workflow. CAD [computer-aided diagnosis] is a helpful support in managing the workload of a screening center such as ours. But this is only one advantage. On the other hand, digital systems help the radiologist and surgeon communicate with the pathologist.
LO: The incidence of breast cancer in Hong Kong has increased to one in 23, and digital mammography is fantastic because Chinese women have very dense breasts. So, advanced digital mammography has really helped to look through the breast tissue, and also in picking up the microcalcifications.

How can ultrasound or other modalities improve the ability to detect cancers?
LO: Ultrasound has always been popular in Hong Kong because of the very dense breasts the women have here. We've always found it to be very useful and complimentary to mammography. MRI, of course, I think is a breakthrough. Like Dr. Ridder, we also have a multidisciplinary approach in our hospital. We communicate very closely with the breast surgeons, pathologists, radiation therapists, and oncologists.

Why is it important to be an early adopter of technology? What are the benefits to patients? To the hospital?
RIDDER: Here in Dortmund, where we are located, we are a city of 1.5 million. We are part of the hospital's Radiology Institute, and we have the pressure of the free market. Women are free to decide which institute they want to go to. Having better technology gives us a competitive advantage. The second thing is that with the new techniques, it is better for the patients. With our advanced radiology equipment, we get the most sensitivity and specificity we can. Mammography is only one small part of all the basic things that have to be offered along with the other modalities.
LO: Our hospital is a private hospital and actually prides itself in getting the best machines. We have a 3 Tesla MRI breast unit, and we've been doing a special sequence called diffusion to look at the breast tissue and had some very good preliminary results that will be published in JCAT *[Journal of Computer Assisted Tomography]* next year and were presented in Toronto at the ISMRM [International Society for Magnetic Resonance in Medicine] this year [2008] in May.

You had a special case as a result of the diffusion study. Can you tell us about that?
LO: One of my patients is a scientist and is aware of what we are doing. Previously, she had standard mammography, but it was not diagnostic because her breasts were very dense. So, we decided she should have the diffusion examination because it doesn't involve any ionizing radiation, there's no injection, and it's very quick. What happened was that the diffusion study unexpectedly turned out to be abnormal. So, this was followed with a complete contrast-enhanced MRI scan, of course, and at the site where the diffusion abnormality was seen, there was actually a bilobulated rim-enhancing mass with type three signal intensity time graph, quite diagnostic like a BI-RADS [Breast Imaging Reporting and Data System][1] five lesion, and this turned out to be DCIS [ductal carcinoma in situ]. After the MRI was done, I suggested doing an ultrasound as well and we saw the lesion again. I also persuaded her to do mammography again because I was afraid she might have an area of DCIS

[1] BI-RADS is a quality assurance tool originally designed for use with mammography. The system is a collborative effort of many health groups but is published and trademarked by the American College of Radiology.



"There are a lot of tools out there that we can parlay into what we are currently doing to add diagnostic capabilities."

John F. Nelson, MD, Medical Director, Battlefield Imaging, Battlefield Auxiliary Breast Center, Ringgold, GA, USA

that's only shown with microcalcifications. Both the MRI and the ultrasound may not show a certain percentage of DCIS cases that present with microcalcifications. Indeed, her tumor was at eight o'clock, but on the mammography at ten o'clock, there was a stipulated area that had some microcalcifications in it.
NELSON: Was the diagnostic MRI also negative?
LO: No, it wasn't. It was an irregularly marginated mass, but it had a type one graph. So it was indeterminate. It was like a BI-RADS four at the ten o'clock lesion, which was seen on mammography, and a BI-RADS five lesion that was not seen on mammography for the eight o'clock.

How are you using other methods of molecular medicine such as PET·CT [positron emission tomography/computed tomography], SPECT·CT [singe photon emission computed tomography/computed tomography], or biomarkers?
NELSON: At our institution, we really reserve PET·CT for women with suspected extensive disease. For most of our women with locally advanced disease, we evaluate with breast MRI, and I bet that is true for the other two physicians. We've actually experimented at our institution with Bruce Porter's techniques[2], and what we're doing now is a lot more whole-body MRI for staging and the chest and abdomen for screening, along with our breast MRI.
RIDDER: PET·CT is also promising in other cancers, like ovarian cancer or lymphatic cancer. Where we use these PET techniques is also for extended breast cancer and the staging of treatment.

How does an integrated diagnostic strategy affect your patients and your facility's success?
LO: Patients who all of a sudden find out they have some abnormality want to find out the exact extent of the abnormality and what it is right away. If you send them to all different types of places to get it and they have to wait, that's tremendously stressful on the patient. We are lucky that we have everything in one place, including the hospital.
NELSON: In fact, that's really why our facility was built. We are actually in a breast center, so every modality, including breast MRI, is available. We even offer Saturday morning service. We're also in a very competitive environment here. We are motivated at our center to place the patient at the center of the wheel and all the spokes go out, but the patient shouldn't have to move. It's our job to provide all the services that go along with breast cancer evaluation.
RIDDER: I think my colleagues will agree, everyone is short of time, and so the time pressure is extreme. Also, women need to get their results in a short time.

Why did you choose women's health and breast cancer as your field of expertise?
RIDDER: Honestly, I think it's one of the most exciting fields in radiology, with all the new techniques that have been

[2] Refer to, e.g., Beatty, J., Porter, B: Contrast-enhanced breast magnetic resonance imaging: the surgical perspective. *Am J Surg* 193; 5:600-605.
Smith J.P., Hanson J., Dawson J., Porter B., Tickman R.J.: emerging technologies in surgical planning for breast cancer. *Am J Surg* 184; 4:377-9.

developed in the last ten, 20 years, and are still being developed. Maybe only comparable to cardiac MRI or multislice computed tomography.
NELSON: For me, it was a calling. My sister was diagnosed with breast cancer back when I was still in medical school. She had two kids. I saw how breast cancer affects the patients, their loved ones and families, and changes the course of life for everybody. So when I got to the point of choosing my area of specialization, it was just natural.

And why did you choose Siemens equipment for your work?
NELSON: Battlefield Imaging was a brand-new center built from scratch alongside the rest of our medical facilities about five years ago. We wanted to go completely digital at our center – no film. We weren't building space for film. I actually flew to Dortmund to look at the digital mammography system they had in place there. We've had a long-standing relationship with Siemens, and we have extremely good Siemens service. A lot of what drove my interest in Siemens was that relationship. When I saw the system and compared it with the other two systems available at the time, I just didn't feel comfortable that either of the others could provide me with the image quality or the back-up service that I knew would be necessary. The same is true for MRI. At that time, the Espree [MAGNETOM® Espree Open Bore MRI system with Tim® technology] was just coming on the market. We have a relatively large patient population; many of our patients are overweight or obese. The Espree just fit perfectly with what we were trying to provide. It was really the first full-field, high-end machine that offered those sort of facilities for the patients. Siemens really had the technology that worked well for us.
RIDDER: It's the whole package you get from Siemens, not limited to just the image quality. For example, we have a different machine that is supposed to have the same detector as the mammography system from Siemens, but there is no comparison between the two images. I'm also using our MRI for heart examinations and work with other Siemens systems as well. Thanks to the common *syngo*® user interface, it is easy to switch between the modalities.
LO: Prior to getting our Siemens digital mammography unit, we had one from a different vendor. We have images from patients who come for follow-up. The old images are from the other vendor and the new images are Siemens, and it's like night and day. The new Siemens unit is seeing so much more, and I'm very pleased with that.
NELSON: I would add that the Siemens digital unit had several filter combinations, some of which use a considerably lower dose. Compared to our screen film, we were seeing 30 to 40 percent lower doses. We have marketed that very strongly in our community, and it has been very well received.

Are you excited about any new trends or innovative leading-edge imaging solutions for the future?
RIDDER: We have just started with ultrasound automated breast volume

"We are lucky that we have everything in one place."

Gladys Lo, MD, Chief Radiologist, Department of Diagnostic and Interventional Radiology, Hong Kong Sanatorium and Hospital, Hong Kong, China

"Having better technology gives us a competitive advantage."

Karsten Ridder, MD, Radiological Group Practice, Outpatient Clinic Prof. Dr. Uhlenbrock and Partners, Diagnostic Breast Center, St. Josefs-Hospital, Dortmund-Hoerde, Germany

scanning [ABVS][3]. We haven't used the technology for a very long time, but what I can say now is that we are looking at a very promising technique that holds a huge potential for breast imaging in the future.

NELSON: I would echo that there are some other things on the horizon. I think all of us are interested to see if breast tomosynthesis[4] is really going to take off. Certainly, we've found elasticity imaging in ultrasound very useful. And I'm really excited about diffusion imaging on MRI. There are a lot of tools out there that we can parlay into what we are currently doing to add diagnostic capabilities.

***Diana Smith** is a freelance writer based in Liberty Hill, TX, USA.*

[3] The information about this product is being provided for planning purposes. The product is pending 510(k) review, and is not yet commercially available in the U.S.

[4] Caution: Investigational Device. Limited by U.S. Federal Law to investigational use. The information about Digital Breast Tomosynthesis is preliminary. This product is under development and not commercially available in the U.S., and its future availability cannot be assured.

Further Information

www.siemens.com/breastcare
www.siemens.com/news-breastcare

Breast Cancer: Where are we – and where are we heading?

Challenge:

"It was easy, and I was out of the scanner in five minutes," says the scientist. "As I came out, I saw the stricken face of the radiologist and knew something was wrong." Working on MRI diffusion, a promising breakthrough imaging technique for the breast, a scientist unexpectedly discovers her own disease. One chance test completely changed her life, but that was just the beginning of an arduous emotional and physical journey.

Solution:

Today, physicians and clinicians are using an arsenal of integrated diagnostics that have revolutionized the management of breast cancer. "I think probably everyone would agree that improved screenings have saved lives," says John F. Nelson, MD, Medical Director of Battlefield Auxiliary Breast Center in Ringgold, Georgia, U.S. "That has really changed the way I practice."

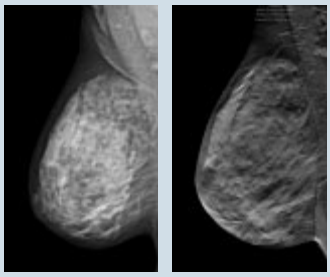
Integrated diagnostics have other benefits, including improved workflow and patient convenience. Gladys Lo, MD, Chief Radiologist at Hong Kong Sanatorium, emphasizes how new approaches to diagnosis and treatment have positive emotional ramifications. "For patients who all of the sudden find out they have some abnormality, they would like to find out the exact extent of what it is right away. If you send them to all different types of places and they have to wait, that's tremendously stressful on them."

Result:

Technologically, huge strides have been made in the imaging field in the last two decades. Integrating laboratory diagnostics, advanced imaging, and information technologies can improve a patient's outcome at every stage of care. In addition, integrated technology affects workflow. "It is much faster and more precise than before," says Dr. Karsten Ridder of St. Josefs-Hospital, Dortmund, Germany.

The journey of detecting, coping with, and beating breast cancer resulted in an enlightened new perspective for the scientist. Now, this survivor gives real advice, not only on early detection and treatment, but also because of her background, specifically on what to look for in hospital imaging equipment and how the level of technology may make a difference in a person's life. All scanners are not created equally.

The ACUSON S2000 ABVS Automated Breast Volume Scanner reduces operator dependence and variability.



Patient with a 2.8-centimeter, grade 3, invasive ductal carcinoma in the right breast imaged with digital mammography (left) and breast tomosynthesis. The mediolateral oblique (MLO) digital mammography view shows dense breast tissue with subtle distortion in the lower breast. The MLO tomosynthesis slice shows a spiculated mass in the lower breast.

MAGNETOM Espree – Pink is a dedicated MR Breast Scanner with a 70-centimeter Open Bore at 1.5T and an ultra-short 125-centimeter system length.

Diverse Imaging Solutions

In a multipronged, comprehensive approach, Siemens combines laboratory diagnostics, advanced imaging, and information technologies to help physicians detect, diagnose, and treat breast cancer earlier, faster, and with greater precision. New technology offers a range of breast care solutions – all designed to contribute to successful disease management.

MAGNETOM Espree – Pink

Siemens announced the latest innovation in breast MRI, MAGNETOM® Espree – Pink, the new dedicated MRI Breast Scanner with a 70-centimeter Open Bore at 1.5 Tesla and an ultra-short 125-centimeter system length. Both the 70-centimeter Open Bore scanner and the new breast coil (Sentinelle Vanguard for Siemens) offer an enhanced level of patient comfort, especially for obese and claustrophobic patients. The system has the capability to position the patient feet-first or head-first and provides excellent access to perform biopsies. Sentinelle Vanguard for Siemens offers excellent image quality and optimized biopsy access for higher accuracy in intervention and faster examination time. The dedicated workplace includes *syngo*® BreVis[1] for flexible reading and reporting and *syngo* BreVis Biopsy[1] for fast and accurate MR breast biopsy workflow with automatic calculation of target coordinates.

ACUSON S2000 ABVS Automated Breast Volume Scanner

The ACUSON S2000™ ABVS Automated Breast Volume Scanner[2] streamlines workflow and reduces operator dependence and variability by quickly and comfortably surveying and acquiring full-field sonographic volumes for comprehensive review and diagnosis of the breast. ACUSON S2000 ABVS features an integrated room suite design that combines the advanced ACUSON S2000 ultrasound system and a column stand with an arm assembly, which holds a transducer pod specially designed for automated ultrasound breast imaging. It supports a high patient load with 250 to 400 single images acquired in one scan to calculate the volumes, which are sent to a dedicated ABVS Workplace for analysis and manipulation. The system features the anatomical coronal plane, which is not available using conventional ultrasound and includes semi-automated reporting features and comprehensive BI-RADS report capabilities.

Breast Tomosynthesis

The latest technology now under development in full-field mammography, breast tomosynthesis[3], is a 3D imaging technology that acquires 2D projection images of a compressed breast at multiple angles during a sweep of the X-ray tube. Poised to enhance mammography, the new technology will take the two-dimensional images and reconstruct them to reveal depth – the third dimension of anatomy. Tomosynthesis slices have the potential to show tumors that remain invisible in individual images.

[1] This information about this product is preliminary. The product is under development and not commercially available in the U.S., and its future availability cannot be ensured.
[2] The information about this product is being provided for planning purposes. The product is pending 510(k) review and is not yet commercially available in the U.S.
[3] Caution: Investigational Device. Limited by U.S. Federal Law to investigational use. The information about Digital Breast Tomosynthesis is preliminary. This product is under development and not commercially available in the U.S., and its future availability cannot be assured.