

Big Images, Small Footprint

Portable ultrasound takes imaging across the hall and around the world

By Jennifer Patterson Lorenzetti

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Ultrasound has been a key diagnostic imaging modality for more than two decades, and sometimes that means it is taken for granted, sitting in the shadow of the newer and more glamorous MR and CT imaging.

However, ultrasound has recently started to move out of the imaging suite and into patient rooms, emergency departments, and even outside the hospital altogether, as improvements in miniaturization and image quality have made the technology portable.

Where It's Used

Ultrasound "is definitely a mature technology," says Jim Brown, director of clinical/technical marketing for the ultrasound division of Andover, Mass.-based Philips Healthcare. He notes that although ultrasound is often utilized for its speed in obtaining images, it also requires a certain amount of technical skill and typically has been limited to larger departments.

Previous generations of the technology have allowed for portable ultrasound machines that can be transported to the patient's bedside, but all were plagued by problems with image quality. "We kept hearing, 'they're OK for a quick look, but we don't feel confident of the image quality,'" Brown says.

The key to obtaining large-scale quality images from a machine that can be easily transported is in the miniaturization. Brown explains that the beam former, which transmits and receives the signal, used to be lower-scale on a portable machine than in a larger version.

However, the technology has now been reduced "to a single chip," allowing for much better quality than previously available in smaller packages. Miniaturization has also allowed for faster and smaller microprocessors, as well as improvements in the transducer, Brown says.

Typically, portable ultrasound in the hospital environment is used in emergency rooms, intensive care departments, cardiac care units, and obstetrics – all areas where moving the patient to an imaging suite would be prohibitive in terms of time or convenience. Some of these applications allow for greater precision in certain procedures and greater comfort for the patient.

Dave Willis, vice president of competitive strategy and innovation for Bothell, Wash.-based



Peder Pedersen, PhD, (left), R. James Duckworth, PhD, (middle), and research assistant Philip Cordeiro (right) demonstrate portable ultrasound with real-time streaming video from sites that have a third-generation mobile communications technology service. (Worcester Polytechnic Institute)



Portable for broader applications, SonoSite's M Turbo allows physicians a wide range of use, from vascular to cardiac exams to abdominal, including the gallbladder image captured using the C60x/5-2 MHz transducer. (SonoSite Inc.)

Sonosite, says, “a lot of the scanning is done by the physician.” He points to the instance of placing a peripheral nerve block, in which the physician traditionally would use a nerve stimulator to get an approximate idea of the location of the nerve and the completeness of the block.

However, “with ultrasound, you can visualize the nerve and needle and see the anesthesia surround the nerve,” he says. This allows for greater assurance that the anesthesia has been properly placed, resulting in less pain for the patient.

Not only can a portable machine ensure greater comfort and efficiency, it can also be a cost-saving move compared to transporting a patient to a central imaging suite. “There are a lot of advantages in taking equipment to a patient; for example, it may take two people to move a patient,” Willis says.

There is a resulting personnel saving by having a single person travel with a portable machine to a patient’s room. Additionally, although some of the larger machines could be transported to the patient, instead of the other way around, this is a very inefficient practice.

“It could take the machine out of the [imaging] room for an hour or more,” says Willis, referencing a study on return on investment that determined that portable ultrasound machines could increase productivity.

In fact, it is in the hospital and clinic environment that portable ultrasound has currently found a home. Claudio Bertolini, president of Indianapolis-based Biosound Esaote, notes that “the majority of portable systems are only used on carts.”

In this case, it is important that the footprint of the machine is small enough to allow for movements; however, minimizing weight is not the highest concern. “It’s not important if it is 7 [pounds] or 15 pounds,” Bertolini says.

Next Steps

Although the majority of portable ultrasound units are used to take imaging to a patient’s bedside in the hospital or clinic environment, the technology is increasingly being used to reach out to even more remote locations. Brown notes that one such application is triage at disaster sites, where quick and portable imaging can make a life-saving difference.

There are systems in development that promise to take portable ultrasound even further into the field, with anticipated use in emergency medicine, rural health, and disaster relief. Peder Pedersen, PhD, of the Maine-based Worcester Polytechnic Institute’s (WPI) Bioengineering Institute, is working with a team to develop portable ultrasound systems that meet a variety of different field needs that are not present for hospital-based equipment.

For example, the team is working to add communications capability to the equipment. “We aim at real-time streaming video from sites that have 3G [third generation mobile communications technology] service.... We [also] plan to have two-way voice communication,” he says.

This communication may allow for better patient care in rural areas, for example, where a sonographer brings portable ultrasound to pregnant women, sending images to and conferring with an obstetrician back at the home-base hospital or office.

The team is also considering the addition of a compact exam camera to allow team members at the home base to see the patient’s appearance or get an external look at an injury, like a compound fracture. This would complement the EKG and pulse oximeter monitor already available on some systems currently in use from other manufacturers.

The WPI system is also highly modular, allowing users to pack it into a vest, carry it in a bag, or even load it on a saddle for veterinary use. An early version of the WPI portable ultrasound system is being flown by a lifeflight unit in Worcester, which allows medical crews to better assess the patient’s condition during transport on helicopter or fixed-wing aircraft flights.



Designed to meet the needs of cardiologists for clear diagnostic data at the bedside, the CX50 CompactXtreme combines the image quality expected of a traditional, premium, full-size system with the convenience of portability. (Philips Healthcare)



Biosound Esaote’s MyLab@25 and MyLab@30 portable ultrasound systems offer performance without compromise over a wide range of clinical specialties. (Biosound Esaote)

In the future, the WPI team would like to add virtual interactive training, something that Pedersen says is important for ultrasound because “it is interactive.” He notes that ultrasound requires more active technologist ability than modalities in which the patient moves through a machine, with settings programmed into a computer.

In this training, a special mannequin would be used to mimic a patient with a specific problem, ranging from an aneurism to gallstones. The trainee could then use an accompanying ultrasound machine to image the area and learn to recognize an abnormality.

Tips for Selection

Hospitals, imaging centers, and other users looking to purchase a portable ultrasound device should be aware that not every machine is suited for every use. Experts suggest purchasers look for a number of different features and attributes.

First of all, the system has to provide an adequate image quality. “We’ve come to a dangerous moment in handheld or portable systems, when some users give up quality because it is smaller,” says Bertolini. He believes this puts a hefty responsibility on both the manufacturers and the end users.

“We need to be very, very serious. We have a strong obligation to deliver good products,” he says, adding that potential purchasers should ask, “Am I 100-percent sure that I am going to get the same level of quality that I get on the big system?”

“It has to be flexible,” says Brown, who advises the machine should be able to be carried by hand or docked on a cart. He also recommends a unit that is easy to use, and features automatic optimization, an attribute that is particularly important in challenging environments or emergency situations. “You don’t have the time to fiddle with controls.”

The specific machine required will also be a function of intended use, with some manufacturers offering specific machines for specific purposes. “We have a machine designed for nerve blocks, and one for PIC [peripherally inserted catheter] lines,” says Willis about some of the Sonosite products. He recommends that those looking to purchase “should be very clear about what they’re trying to do clinically.”

Additionally, “people tend not to ask [about the warranty,] but it is very important,” says Willis, noting that his company’s products carry a standard five-year warranty. This is especially important for equipment that will be taken into situations where damage or problems are perhaps more likely.”

Therefore, “durability is also key,” he says, emphasizing the company’s “three-foot drop test to a cement floor – not just for the system, but also the transducer.” Two further factors are critical on these portable systems. First is infection control, so users may also want to ask if the system is sealed, especially the keyboard, and can withstand a thorough cleaning.

Finally, systems that will be taken into the field will need a long and reliable battery life. All of this portability and image quality may not come cheap. “You’re going to get what you pay for; they are usually some of the most expensive products,” says Brown.

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