

# Ultra Assessment Tool



An Odessa (Texas) Fire Dept. EMS crew views an ultrasound image of a fetus while en route to the hospital.

# EMS crews begin using portable ultrasound units in the field

Story & Photos by Charles A. Smith

Imagine how helpful it would be if you could actually view a patient's heart to see the strength or weakness of the contractions. What if your patient assessment could include a virtual tour of a trauma patient's abdomen? What if you could be alerted to the presence of a fetus when you assess a female patient complaining of abdominal pain or associated symptoms? The ability to see inside the body could have many benefits and make a positive impact on patient care and outcome. These ideas may seem too futuristic for some to imagine, but for the past three years, the Odessa (Texas) Fire Department (OFD), with the encouragement and assistance of its medical director, has enjoyed the benefits of advanced patient visualization through the use of portable ultrasound technology.

Under the direction of Dave Spear, MD, medical director for OFD and a board-certified emergency department (ED) physician at Medical Center Hospital, OFD began an experimental program in May 2000 that featured paramedic use of ultrasound technology in the prehospital setting. The experiment succeeded so well that the procedure is now a normal part of Odessa's EMS care plans.

The experiment was well underway when Odessa fire officials read an article titled "20 Questions about Emergency Stroke and Cardiac Care," in October 2000 *JEMS* by Chad Brocato, EMT-P, an instructor for the Center for Research in Medical Education at the University of Miami School of Medicine. In the

article, Brocato included an interview with Donald Rosenberg, MD, EMS medical director for Miami-Dade (Fla.) Fire Rescue EMS Division and professor of clinical medicine (cardiology) for the University of Miami School of Medicine. Rosenberg, expressing what he believed to be in the future for EMS, said,

*From a technological perspective, EMS systems may investigate training paramedics to perform echocardiograms in the field. Though complex to interpret, this non-invasive diagnostic tool may prove beneficial in identifying an acute MI before the ECG begins to show any changes. This portable, yet powerful technology may also be useful in identifying pericardial tamponade, intraabdominal hemorrhage, dissecting aneurysm and pneumothorax.*

Rosenberg's statement was of particular interest to Spear and the Odessa staff because it supported what they had already concluded from actual use: The ultrasound is as useful in the field as a cardiac monitor.

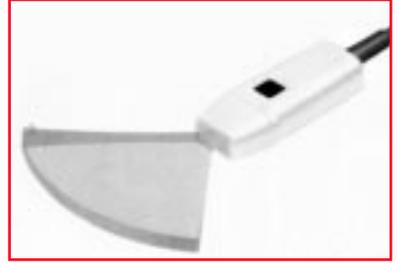
## Preliminary steps

Spear felt it was time to move ultrasound technology to EMS field use. "The introduction of ultrasound equipment to paramedics in the field is a new and exciting idea," says Spear. "Ultrasound machines have already become a valuable tool in the emergency department (ED). Ultrasound technology is now portable, affordable and proven to give valuable information. It's now feasible for



Figures 1A and 1B: Areas with fluid (A) can be seen clearly and appear black. Gas or air (B) scatter ultrasound waves.

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**Figure 2:** The “slice” being viewed is shaped like a flattened cone.

paramedics to use ultrasound machines in the field.”

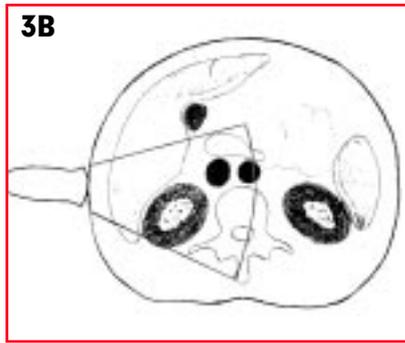
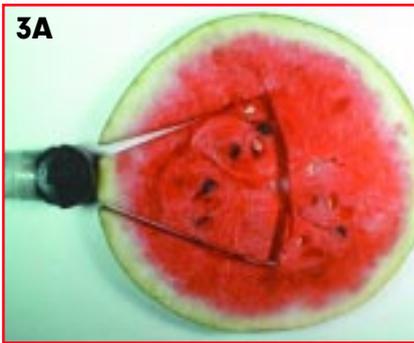
OFD EMS possessed all the attributes Spear thought important to the success of his ultrasound field test. The ED and trauma services at the department’s primary receiving hospital supported the use of ultrasound, and the service had a high EMS call volume.

Spear’s desire to see ultrasound used in the field was based on a common problem encountered by prehospital personnel: When a trauma patient is unstable and in shock, paramedics presume that one possible source could be intraabdominal blood loss, but they have no way to verify that in the field.

Spear knew that with the introduction of an ultrasound unit, OFD personnel could quickly identify intraperitoneal blood and transmit this information to hospital ED staff prior to arrival at the facility. This advance notice would allow time for ordering O negative blood and alerting the ultrasound department, the trauma surgeon and the operating room staff, which could make a significant difference in patient outcome and make better use of the Golden Hour.

### **Selling the program**

Spear needed to convince several people that his prehospital ultrasound idea had merit. The field-testing would be easy enough, but Spear had to persuade his ED colleagues, along with the radiology, cardiology and trauma services of the benefits. The ED physicians knew the value of the ultrasound equipment when the patient arrived at the hospital, but many were initially skeptical of paramedics performing the procedure. After hearing Spear’s enthusiasm and excitement over the field use of ultrasound technology, his colleagues offered support for the program.



**Figure 3A and 3B:** The cross-section of a person looks like a watermelon slice on screen (A). The ultrasound “slices” seen here focus on a small segment of the anatomy (B).

## Training & implementation

Spear contacted the Sonosite Corp. and requested the use of a few sonogram machines for his field test. He scheduled training for two of Odessa’s busiest fire stations. All paramedics at the participating stations were trained in the use of the ultrasound units by using volunteer patients, animals and human cadavers.

Spear trained the Odessa paramedics to perform and read the ultrasounds. The training and field-testing was focused on two primary areas: internal blood loss and cardiac contractility. The paramedics learned quickly from the material provided by Spear’s hands-on, individual instruction, learning to use the portable ultrasound equipment in about an hour.

The paramedics were then cleared by Spear to use the equipment. One of Spear’s requirements is that paramedics never delay patient care and transport because of ultrasound use. Spear’s training emphasizes that the ultrasound is an adjunct to quality prehospital assessment. Odessa’s paramedics, therefore, perform the procedure while en route to the ED.

The results exceeded Spear’s expectations and proved to all concerned that paramedics could obtain early, accurate, diagnostic information by using ultrasounds, saving valuable time in the assessment and treatment of trauma, cardiac and obstetric patients.



**Figure 4:** Position 1—right lateral



**Figure 5:** Position 2—low abdominal



**Figure 6:** Position 3—subcostal



**Figure 7:** Position 4—left parasternal

## Ultrasound cost & funding

The portable ultrasound units are priced comparably to cardiac monitors. Sonosite Corp. provided several devices to Odessa for the trial period. The

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**TABLE 1: Pre- & Post-Ultrasound Diagnoses**

| Complaint                                           | Probable diagnosis | Actual diagnosis                     |
|-----------------------------------------------------|--------------------|--------------------------------------|
| 72-yr-old male with abdominal pain                  | Gastritis          | AAA (abdominal aortic aneurysm)      |
| 42-yr-old female with abdominal pain                | Gastritis          | Ruptured bleeding, ectopic pregnancy |
| 35-yr-old MVA victim                                | No internal injury | Organ hemorrhage                     |
| 70-yr-old with complaint of a possible kidney stone | Kidney stone       | AAA (abdominal aortic aneurysm)      |
| 68-yr-old with neck pain                            | Muscular           | Thoracic aneurysm                    |
| 21-yr-old stabbing victim                           | Missed the heart   | Pericardial tamponade                |
| 19-yr-old female with flank pain                    | Kidney stone       | Labor, delivery                      |

remaining equipment was purchased through grants Spear obtained from the Texas Department of Health, the U.S. Department of Agriculture (USDA) and Sonosite Corp.

### “Worst case” medicine

In emergency medicine, prehospital personnel are obliged to suspect the *worst* problem a patient’s symptoms present. The symptoms of a young female experiencing a terrible stomachache lead her

to believe she has food poisoning or the flu. But to emergency personnel, her symptoms may indicate a ruptured ectopic pregnancy with internal hemorrhage or a ruptured appendix, saving the ED team valuable time in arriving at a final diagnosis.

Table 1 (above), offers examples of classic prehospital cases, along with the chief complaint presented to Odessa crews, the probable diagnosis and actual hospital diagnosis.



OFD Fire Medic Unit

## City of Odessa Fire Department

The Odessa Fire Department (OFD) was established Sept. 27, 1927, and began providing EMS on July 24, 1973. What began as a one-vehicle, seven-member department has grown to eight fire stations, equipped with ALS engines, five front-line ambulances and two demand units. OFD’s 153 active-duty personnel provide fire and EMS service to approximately 125,000 people in an area of 904 square miles. Under the direction of Fire Chief Steve Pollock, the department continues to be proactive and innovative with the EMS and fire services it provides. Odessa was the first Texas city to provide citizens with a 9-1-1 emergency access system, deploy the Jaws of Life rescue tool and have state-certified ambulances. Therefore, being first to deploy and use ultrasound units on its ambulances is a natural progression for OFD.

—CAS

The OFD case distribution for use of EMS ultrasound has been similar to ED use of the advanced technology: 70% pregnancy, 15% trauma and 15% cardiac.

### **Basic ultrasound principle**

The instructional program Spear developed explains the basic principles of the ultrasound to EMS crews, clarifying the difference and significance of viewing air vs. fluid. Fluid produces a black image, and air or gas appears as scattered ultrasound waves (see Figures 1A and 1B, p. 47).

The monitor's transducer projects an ultrasound beam on the monitor screen, exhibiting a slice of the body anatomy in the shape of a flattened cone (see Figure 2, p. 48). In explaining the anatomy slice, Spear asks his students to think of the human body as a watermelon. The ultrasound probe produces an image of the body similar to a cross section of a watermelon slice (see Figure 3, p. 49).

Spear demonstrates optimal ultrasound probe positioning on actual patients so the paramedics can best view the desired anatomy. The paramedics learn four specific probe positions most useful for viewing the anatomy (see Figures 4–7, p. 49).

Spear presents the reasons for ultrasound use on trauma patients, the images to look for to detect fluid in the abdomen and the most likely locations where fluid might be detected. He emphasizes the reason for ultrasound use is to save valuable time for the Golden Hour and stresses that crews shouldn't delay transport.

During training, Odessa paramedics view abdominal images on an ultrasound monitor to familiarize them with the anatomy and appearance of fluid. Spear explains that fluid released in a supine patient would collect in the deepest and most posterior part of the abdomen, known as Morison's pouch (also referred to as the *hepatorenal pouch*), located between the right kidney and liver (see Figure 8, p. 52). Spear points out that more than 500 cc of blood must usually be present to be visible on the ultrasound (Figures 9–11, p. 52, exhibit blood pooling in the abdomen).

Because the most common use for

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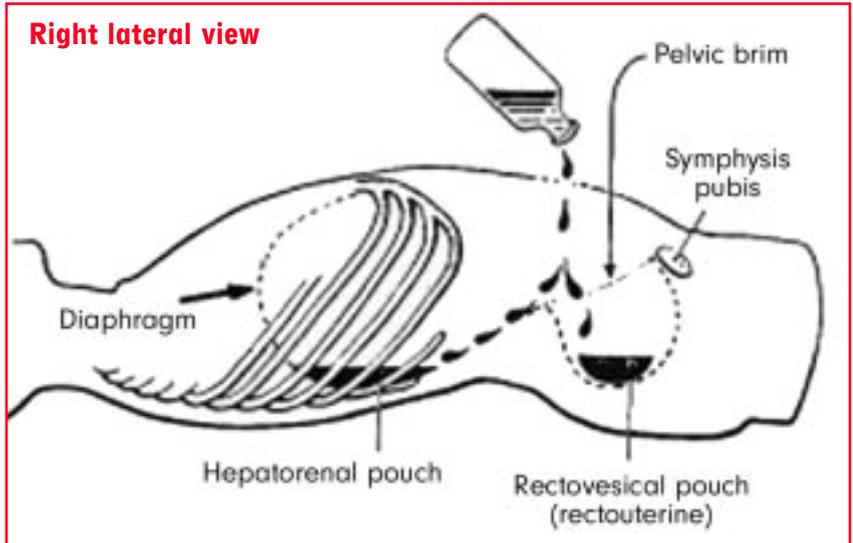


Figure 8: Morison's pouch—where fluid settles

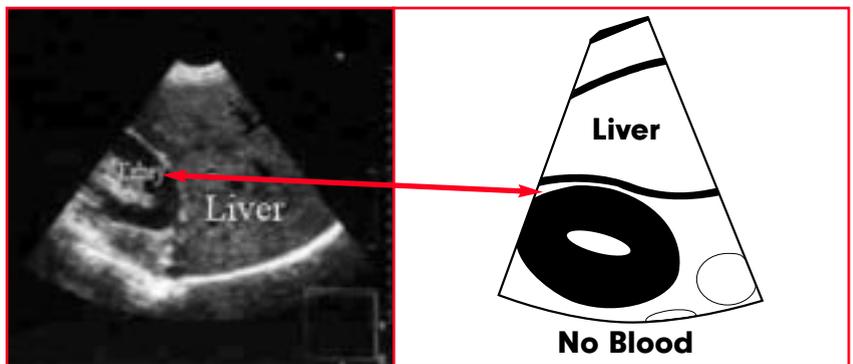


Figure 9: No blood visualized

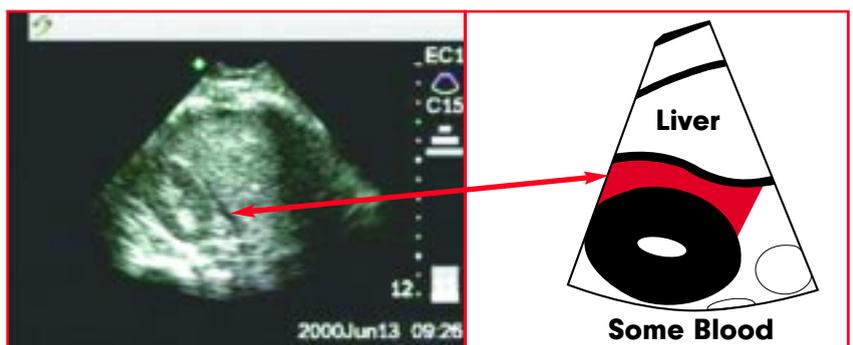


Figure 10: Some blood visualized

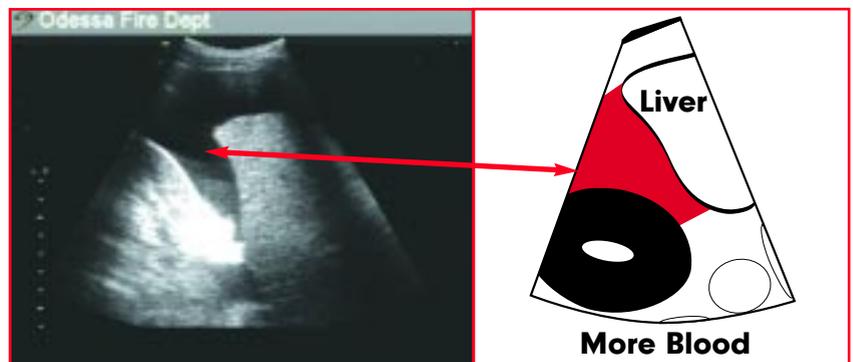


Figure 11: Large area of hemorrhage visualized

the ultrasound is for woman of child-bearing age with abdominal pain, pregnant patients or those suspected of being pregnant, Spear advises the crews on how to appropriately ask questions about a patient's sexual history. Worst-case scenarios, such as ruptured ectopic pregnancies, active labor and fetal demise, are also reviewed.

The concept behind ultrasound imag-

ing is the same as that of a sonogram or echocardiogram. Odessa paramedics didn't initially realize that ultrasound imaging would be beneficial in cardiac cases. However, that changed when Spear taught them to use the ultrasound monitor to determine cardiac motion and rate, as well as the presence of pericardial tamponade—a ring of fluid surrounding the heart (see Figure 12, p. 54).

## An EMS Medical Director's Perspective on Ultrasound Use in the Field

Dave Spear, MD, FACEP, is EMS director for the Odessa Fire Department. He also serves as an attending physician at Medical Center Hospital and as an assistant professor at Texas Tech University School of Medicine, Odessa, Texas. Spear is a former EMT and paramedic who never forgot his roots. Below he offers his unique perspective on the use of ultrasound units in the field.

"Portable ultrasound is going to be vital to the future of emergency medicine," says Spear. "We're going to get to the point where we'll be able to perform a sonogram on every critical case in the ambulance and diagnose many serious conditions prior to arriving at the hospital. I feel it's only a matter of time until it becomes the standard of care. Who would have thought that doing 12-lead EKGs in the field would become a standard procedure? And it has."

Spear has long considered ultrasound valuable in the critical period during which emergency patients are transported to hospitals. "The vast majority of hospitals in this country do not have specialized surgeons staffing their emergency department 24 hours a day," he says. "Instead, when a major trauma occurs, surgeons have to be called in. By putting ultrasound in the hands of paramedics who are trained to use it, we can get the ball rolling a lot sooner. In addition, ultrasound can be used to better assess female patients with abdominal problems. Many times these patients don't know that they're pregnant and discovering this can be very helpful. Ruptured ectopic pregnancies are fairly easy to diagnose in the field, allowing the hospital to prepare for such patients.

"When I started teaching the paramedics to use sonogram machines in May 2000, there was an initial intimidation factor," he says. This apprehension melted away after the paramedics began the hands-on portion of their training. "They were reluctant until they saw something they could recognize on the screen, and then they lit up. They realized that the sonogram could help tell them vital information. Now they tell me, 'If you take this away from me, you'd take away a very valuable tool.'"

Spear is thrilled with the impact of portable ultrasound on his team's ability to accelerate vital care in emergency situations. He's particularly impressed by the sonogram's impact on emergencies in rural areas, where patients can be located 90 minutes away from a hospital. "A quick ultrasound examination can set off a cascade of faster, more responsive treatment," says Spear. "We have just begun placing ultrasound machines in remote places. For example, Terlingua paramedics now have the capability to obtain a sonogram and transmit the images for physician review."

But this is just the beginning. Imaging patients in the field is new. Spear says, "Here's the best news: The same data transfer systems we use in the field are capable of transmitting other images. We're now working on a project that involves using fluoroscopy transmitted from the Big Bend National Park to allow emergency physicians to diagnose fractures and discuss treatment plans with the paramedic and their patient. CAT scan is coming!"

—CAS



Figure 12: Pericardial tamponade visualized

The paramedics also learn to determine if the heart's motion is normal or weak and to view the heart in subcostal and left parasternal positions (see Figures 13A and B, right).

### Putting it all together

The sonogram machines have been used on Odessa ambulances for three years. Paramedics have scanned hundreds of patients and examined patients presenting with heart attacks, abdominal injuries, ruptured ectopic pregnancies and fetal conditions. Images from the Odessa ultrasound units can be recorded on a disk and then presented to the ED physician on arrival at the hospital.

The paramedics have used their compact, ultrasound units to confirm patients with pulseless electrical activity (PEA) and view the motion of the heart during CPR to help detect spontaneous motion and blood flow. They have even recorded images of an arrested heart regain its rhythm with the help of a pacemaker.

When the ultrasound uncovers an abnormal fluid accumulation or mass during patient assessment, the paramedics immediately notify the ED, allowing hospital staff extra time to prepare for the patient's arrival.

The cost of the ultrasound units did present an obstacle that Spear and the fire department had to overcome to place the devices on all Odessa ambulances.

The ultrasound monitor has become a



Figure 13A & 13B: Cardiac motion can be viewed from the subcostal (A) and left parasternal (B) probe positions.

valuable addition to OFD ambulances, one that crews use frequently to give them a special look into a patient's body to detect problems and aid them in their assessment and treatment of patients.

The Odessa Fire Department has shown that as technology improves and the medical community accepts the adoption of innovative ideas in the prehospital setting, patients will benefit from the use of advanced diagnostic tools previously restricted to hospital use. JEMS

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See Hands On, p. 86, for a look at Sonosite's latest ultrasound unit.