Clinician-Performed Ultrasonography During the Boston Marathon Bombing Mass Casualty Incident

To the Editor:

Although the use of clinician-performed ultrasonography has been described during military and international mass casualty events, there is limited evidence on its use in domestic mass casualty events. We describe the role of ultrasonography at our facility during the Boston Marathon bombings and provide suggestions for diagnostic imaging processes during disaster response.

On Monday, April 15, 2013, 2 explosive devices were detonated near the finish line of the Boston Marathon. Our Level I trauma facility received 39 patients, 19 in the first 30 minutes, many of whom were critically injured. Although we easily mobilized manpower, we found that the standard protocols for diagnostic imaging were quickly overwhelmed. The radiology technicians struggled to meet the demand for portable radiographs, and the number of unidentified and unregistered patients made linking images with individual patients problematic. Because the volume of critically injured patients quickly overwhelmed standard radiography processes, providers turned to bedside ultrasonography for diagnosis and triage.

One of the first patients to arrive had an actively bleeding penetrating neck injury from shrapnel. She was quickly intubated and a portable chest radiograph was obtained, yet there was a significant delay in image processing. Bedside ultrasonography revealed no pneumothorax, hemothorax, pericardial effusion, or intraperitoneal free fluid. Reassured that this was an isolated neck injury, the providers moved on to care for other patients.

Many of the patients sustained blast injuries of the lower extremities, and evaluating for concomitant intra-abdominal trauma was critical in triaging patients. In one pod, a senior resident went bed to bed, performing an extended focused assessment with sonography in trauma examination on each patient. During normal patient care, all bedside ultrasonography results are recorded with a patient identifier and logged in the electronic medical record. Lacking the time for complete documentation, the resident documented the ultrasonographic results on a piece of paper, which was then taped to the corresponding stretcher.

We also discovered the importance of appropriate equipment. In one of our pods, we have an older ultrasonographic system without battery backup. The providers reported that the lack of a battery pack or a rapid boot time significantly hampered their ability to effectively incorporate ultrasonography.

Of the 39 patients, 9 went directly to the operating room. The remaining patients were treated for a spectrum of minor to more moderate injuries. In accordance with our experience, the triage and acute care of these patients was crucially informed by the results of the bedside ultrasonography.

Given the ubiquity of emergency ultrasonography in both academic and community settings, we suggest that disaster planning include altering the standard imaging protocol to prioritize ultrasonography. We recommend that emergency departments maintain adequate resources, including a portable ultrasonographic machine capable of running on a battery in each clinical area. In addition, departments should consider developing alternative image documentation protocols for use during mass casualty events to improve efficiency while maintaining the ability to communicate crucial medical information to other providers. In summary, clinician-performed ultrasonography proved to be an indispensable tool during the Boston Marathon mass casualty events, and domestic disaster planning should address ultrasonographic resources and provider training to ensure that this technology is available when the need next arises.
Funding and support: By Annals policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see www.icmje.org). The authors have stated that no such relationships exist.


IMAGES IN EMERGENCY MEDICINE
(continued from p. 194)

DIAGNOSIS:
Limb-threatening frostbite receiving thrombolytic reperfusion therapy. Patient 1 responded well to thrombolytic therapy, with angiographic and clinical improvement; he recovered completely. Patient 2 did not benefit from thrombolytic therapy, with persistent lack of distal angiographic perfusion. He required bilateral digital amputations.

Major risk factors for frostbite include homelessness, intoxication, psychiatric illness, and wintertime recreational activities. Feet, hands, ears, nose, cheeks, and penis are most vulnerable. Deep frostbite extends through the dermis, injuring muscle, bone, and vascular structures.

The pathophysiology of frostbite-induced tissue damage involves vasoconstriction, ischemia, reperfusion injury, endothelial damage, and initiation of the inflammatory cascade. This results in edema, micro- and macrovascular thrombosis, and progressive tissue ischemia and necrosis. Although the initial treatment for deep frostbite is rapid rewarming in a 37°C to 39°C waterbath and avoidance of further trauma,1 tPA administration shortly after rewarming has demonstrated promise.2,3

Patients with hemorrhagic blisters, nonblanching cyanosis, indurated skin, and absent Doppler pulses should be considered for tPA within 24 hours of rewarming. The usual contraindications to tPA apply. Imaging (angiography, magnetic resonance angiography, or technetium-99 triple-phase scanning) is required to confirm compromised distal perfusion. Both intravenous and catheter-directed intra-arterial tPA have proven effective. Heparin is administered concurrently. Repeated imaging every 12 to 24 hours is required to determine treatment effectiveness. tPA administration is terminated when distal perfusion returns or after 48 hours of infusion.

Author affiliations: From the Department of Emergency Medicine (Dolbec, Higgins) and Department of Radiology (Riedesel), Maine Medical Center, Portland, ME.

REFERENCES