

Literature Review and Recommendations
Efficacy of Ultrasound Use in the Pre Hospital Setting
EMS Bureau Protocol Review Steering Committee

Background

Increased portability and ease of use of modern ultrasound machines initially led to non-radiologists adopting the technology in a host of environments, including obstetrics, surgery, emergency medicine, and others. Recently there has been increased use of these devices outside of the hospital as well. Physicians, military medics, and emergency medical services (EMS) personnel have used portable ultrasound machines in the field to diagnose conditions such as pleural, peritoneal, and pericardial effusion and deep venous thrombosis.

In New Mexico, it is common for non-physician EMS crews to focus on rapid transport of patients to emergency departments. In other areas, providers spend more time on scene evaluating and managing patients when physicians are part of the field team. Thus, the indications for and utility of point-of-care ultrasound may differ based on the practice environment of a particular provider.

Question

Is there feasibility for ultrasound deployment in the pre-hospital setting? Do authors in similar environments find portable ultrasound to have great utility in the field or during patient transport?

Method

NMDOH digital library; keywords searched: pre-hospital, ultrasound, sonography, trauma, heart failure

Search engine used: PubMed, Clinical Trials

Review process: A review of the literature was conducted using two electronic medical literature databases. Medical Subject Headings, keywords and a pre-hospital search filter were used to yield relevant literature.

Number of articles reviewed: Seventeen

Number of articles deemed to be relevant: Twelve

Types of Articles: Four prospective observational studies; one survey conducted at a conference of New Mexico physicians; one pilot study

Articles cited to draw conclusions and formulate recommendations: five articles were selected for this review

Results

In Hennepin County, MN, paramedics from two agencies were trained in focused abdominal sonography for trauma (FAST) and aortic aneurysm (AA) ultrasound examination techniques in a six-hour course. Paramedics completed ultrasounds in the field using a prospective convenience methodology. During the study, 104 patients had an ultrasound performed. 20 of these were AA exams, all of which were interpreted as negative by the paramedics. This finding was confirmed in all 20 ultrasounds by a physician over-reader. Additionally, 84 FAST exams were completed, with 6 of these being read by the paramedics as positive for free intraperitoneal/pericardial fluid. These 6 ultrasounds were also confirmed by the physician over-reader. The ultrasounds were performed in the ambulance without scene delay, and paramedics were unable to obtain adequate images in only 8 of the 104 patients. The physician over-reader agreed with 100% of the paramedics' ultrasound interpretations.¹

Another study used a hand-held ultrasound device to perform focused abdominal sonography for trauma (FAST) on blunt trauma victims at two facilities. Results were compared with findings determined through formal FAST examinations (FFAST), CT, operative findings and serial examination. The ability of hand held FAST to detect free fluid, intra-abdominal injuries and injuries requiring therapeutic interventions was assessed.² The hand held FAST was positive in 80% of 313 patients who needed surgery or angiography and missed or gave an indeterminate result in 3% of 270 patients with injuries who required therapeutic intervention and 25% of 270 patients who did not require intervention.² These results were comparable to a formal FAST performance. This study showed that a hand held FAST performed by trained providers can detect intraperitoneal fluid with a high degree of accuracy. They will miss some injuries, but most of the injuries missed did not require therapy. Hand held FAST provides an early extension of the physical examination but should be complemented by the selective use of CT, rather than formal repeat ultrasonography.²

Rugolotto M, Hu BS, Liang DH, et al. conducted a study whose aim was to evaluate image quality and accuracy of a new hand-carried ultrasound device when compared to standard echocardiography in the setting of a focused examination in the assessment of cardiac anatomy.³ They concluded that image quality and diagnostic accuracy of the hand-carried device was adequate for the purpose of performing a focused assessment of a limited number of 2D and Doppler parameters for the evaluation of cardiac anatomy and function.³

A prospective study was performed in a French teaching hospital to evaluate the usefulness of ultrasonography examinations as a diagnostic tool for emergency physicians in out-of-hospital settings. Eight emergency physicians were given ultrasound training for out-of-hospital diagnosis

of pleural, peritoneal, or pericardial effusion; deep venous thrombosis; and arterial flow interruption. It was determined that out-of-hospital ultrasonography increased diagnostic accuracy in out-of-hospital settings.⁴

A 2014 survey of National Association of EMS physician EMS directors showed 22% of respondents considering using ultrasound in the prehospital setting. The devices are becoming more durable and cost-effective, which adds to their allure.⁵ New devices and applications have been explored by military medicine during recent conflicts with some outstanding results. This success has led to domestic proponents and an increasing number of EMS systems evaluating it. The clinical benefits have been both significant and varied.

Ultrasound sonography can quickly and definitively identify abdominal bleeding and pneumothorax. It can also provide real time imaging of the heart and great vessels. It can even find tough veins for an IV. Ultrasound is the first practical technology to offer EMS any kind of imaging capability.

Discussion

Ultrasound has been around for years, but little understood by EMS providers. The focus on rapid transport and limiting on-scene time may have contributed to slower adoption of prehospital ultrasound into clinical algorithms. Ultrasound use has been described in several helicopter EMS programs in New Mexico but there is less experience in the routine use of ultrasound on ground ambulances. The challenge stems from the fact that EMS has long relied on signs and symptoms, things you can see, feel, and hear from outside the body to assess a patient. Not having much frame of reference on imaging has been a barrier to the consideration of ultrasound use in the field by EMS providers. That doesn't make it less potentially important or viable.

New Mexico physicians have discussed utilizing part of an existing trauma-based ultrasound procedure to help guide care of patients in cardiac arrest. "Ultrasound in Prehospital Cardiac Resuscitation," began with acknowledging the key role prehospital providers play in that effort.

The focused assessment with sonography for trauma (FAST) examination could be a starting point for moving ultrasound into the field. FAST is a helpful, noninvasive means of identifying fluid where it does not belong in trauma patients. When examining with ultrasound in the subxiphoid position, the operator can observe the presence of any pericardial fluid and how much "squeeze" affect the heart is producing.

Another common indicator for use would be where a patient is showing pulseless electrical activity (PEA): "We often have the hardest time on patients with extended PEA. If we could look and find additional signs to support continued care, we could better serve the patient. We could change methods and pharmaceuticals to be more appropriate to the patient's needs."⁵

Preparation for mass casualty incidents (from natural or other disasters) has become a major focus of training for prehospital providers around the globe in recent years. Triage of casualties to an appropriate level of care or disposition is paramount; EMS providers are often faced with an overwhelming number of injured that must be assessed rapidly.

Ultrasound is a well-defined skill set with accepted standards and readily available curriculum. This is something EMS can learn to do, if they have the time, money, and commitment to do it. In many areas in New Mexico that really won't be an option. But in some, it certainly could and perhaps should be. It would require funding and dedicated training time.

Recommendations

- For a subset of patients, field ultrasound is a potentially beneficial assessment modality during transport and treatment by paramedics. New technology has made this option feasible to EMS agencies.
- A rigorous protocol, including online physician consultation and field ultrasound, should be developed as a special skills package for several target agencies throughout New Mexico to trial this assessment modality, and allow the accrual of data.
- The EMS Bureau will work through the New Mexico Environment Department Radiation Control Bureau Medical Imaging & Radiation Therapy Program to assure regulatory compliance with their specific statutes and rules for caregivers utilizing ultrasound.
- Once regulatory issues are mitigated, target agencies should be ALS level and 12-lead EKG capable. Target agencies should also have good radio, phone, and telemetry coverage in the majority of their response area (such that the focus of the study is on the treatment and methods, not communications logistics).

References

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