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Ultrasound Use in HEMS

INTRODUCTION

Ultrasound is a form of medical imaging that offers portability, is non-invasive, and does not expose the patient to radiation. Ultrasound use enables practitioners to obtain immediate anatomical, diagnostic, and functional information on their patients. Without a doubt, emergency department ultrasound use has been shown to reduce morbidity and mortality in critically ill patients. Naturally, one must wonder if we can apply this diagnostic tool to the world of helicopter emergency medical services (HEMS).

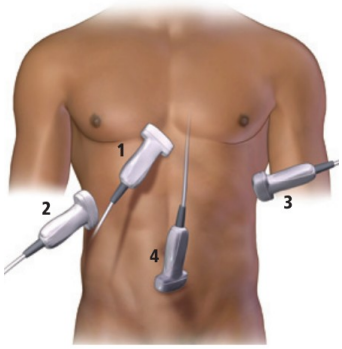
Currently in the US, it is estimated that more than 300,000 helicopter and 150,000 fixed wing transports occur every year. Evidence shows that prehospital ultrasound may be beneficial in diagnosis and management of critically ill patients and could be useful in as many as one sixth of HEMS missions. The rapid growth of HEMS transport in the United States has mandated that we explore better ways to improve care in critically ill patients. Diagnostic ultrasound has been widely used since the early 1980s, but machine cost and size has limited its use to in-hospital environments. Recent advances in technology have decreased unit size, weight and cost, improved durability, and enhanced image quality making ultrasound more accessible to prehospital care providers. A wireless ultrasound probe has even been recently developed for use with the iPhone and iPad. Let's take a look at the applications of prehospital ultrasound and the pros and cons of its potential implementation in HEMS.

CLINICAL APPLICATIONS IN HEMS

Trauma Care –

In patients who have experienced penetrating thoracic trauma or blunt trauma, early detection can be extremely beneficial in recognizing the critically ill patient and expediting them to definitive care. The Focused Abdominal Sonography for Trauma (FAST) exam has been shown to provide a much higher accuracy in detecting free fluid in the abdomen or cardiac tamponade when compared to a traditional physical exam, by examining the following 4 vital areas:

1. The Pericardiac Sac
2. The Hepatorenal (Morison's) Pouch
3. The Splenorenal Pouch
4. The Pouch of Douglas



The average time that it takes to perform a FAST exam is 2-4 minutes and on average it can be completed approximately 35 minutes prior to an emergency department FAST exam. An abdominal Computed Tomography (CT) scan has far better accuracy for determining torso injuries, but the FAST exam can be very useful in situations where CT is not practical due to time constraints and sometimes can help avoid a CT scan all together.

Suspected pneumothorax is another area where prehospital ultrasound in trauma may be useful by avoiding harm from unnecessary field interventions such as needle or tube thoracostomy. By the use of ultrasound enroute to the hospital, potential harm from invasive procedures could be avoided.

Medical Care –

Traumatic injury remains the most commonly cited indication for HEMS ultrasound, but several studies have examined the use of ultrasound in medical illnesses as well. Early evaluation of cardiac arrest and potential detection of PEA are a few of the other conditions where prehospital ultrasound could be useful. Through the detection of cardiac motion, ultrasound has been shown to help differentiate between true Pulseless Electrical Activity (PEA) and pseudo-PEA. HEMS protocols that use asystole or PEA for determining cessation of field resuscitation can therefore benefit from utilizing ultrasound in such protocols.

Other Applications –

- Vascular access – Ultrasound is a useful tool in obtaining central or peripheral lines in difficult access patients.
- Fetal monitoring – Due to ambient noise levels in the aircraft, traditional Doppler monitoring of fetal heart tones is often impractical, if not impossible. Bedside ultrasound can help evaluate and guide care in obstetric emergencies.
- AAA detection – Ultrasound of the abdominal aorta has been shown to be highly accurate for the detection of AAA and to decrease time to the OR in a ruptured AAA.
- ETT placement confirmation – ETCO2 is the "gold standard" in confirming ETT placement, but it has its limitations in such cases as cardiac arrest, low cardiac output, acute pulmonary edema, and hypothermia. Ultrasound offers an alternative method for determining correct placement, detecting displacement or mainstem intubation.
- CVA detection – When performed by highly trained neuro physicians, rapid field detection of an ischemic stroke was possible and helped expedite treatment.

CHALLENGES IN PREHOSPITAL ULTRASOUND

EMS Training and Skill Maintenance –

A variety of practitioners have used portable ultrasound in both air and ground environments. In the United States, HEMS crews consisting of Flight Nurses and Flight Paramedics have been trained in prehospital ultrasound use. Training for these practitioners ranges from 3-7 hrs. Through multiple studies, it has been determined that through relatively short training courses, prehospital providers can acquire the necessary skills to perform prehospital ultrasound. Maintenance of these learned skills, like any other skill, requires practice and quality management programs with continual physician oversight.

Financial Impact –

A great concern with the implementation of a prehospital ultrasound program is the associated costs. The new hand held ultrasound machines, such as the Vscan by GE, can cost as much as $9,000, which is a significant cost for most organizations. When you take into account the cost of the equipment, along with the number of units an organization would need in order to cover a large proportion of patients, the overall cost could be overwhelming and deplete financial resources.

Impact on Patient Outcomes –

Despite all of the previous information documenting the benefits of prehospital ultrasound, including improved diagnostic accuracy, studies have shown that there is a lack of evidence showing whether or not it actually improves treatment of trauma patients. Actually, current evidence has not shown to improve morbidity and/or mortality in critically ill patients. It has even shown to result in a time delay from scene to hospital by 0-6 mins. Before the implementation of a HEMS ultrasound program, most medical directors would like to see more evidence showing that such a program actually improves patient outcomes.

CONCLUSION

Prehospital emergency ultrasound has the potential to improve trauma, cardiac, and obstetric care by reducing morbidity and improve outcomes in patients with life-threatening emergency conditions. It does, however come with some challenges including training requirements and time limitations. As cost, machine size, and ease of use continues to improve, out of hospital ultrasound usage will continue to increase. Although the potential for HEMS ultrasound is great, more outcome research is needed to provide stronger evidence on its clinical impact on patient outcome and to help determine whether it should be deployed more widely.

REFERENCES

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