Point of Care Ultrasonography by Novice Medical Students for Detecting Inferior Vena Cava Collapsibility, Aortic Diameter and Overall Left Ventricular Function in Euvolemic Pediatric Patients

Bryant Dixon, Anthony Han, Khiem Hoang, Michael Cooper MD, Jennifer Dickinson MD, Juan Mark Rendon MD, Steven Field DO, Lynn Roppolo MD

Department of Emergency Medicine
University of Texas Southwestern

UT Southwestern Medical Center

children's health®

Background

Point of care ultrasound (POCUS) is a useful tool in assessing volume status, general cardiac function, and contractility in the emergency department. Research has shown that medical students are capable of learning and performing POCUS, however further research is warranted to assess medical student's ability to perform POCUS, specifically in the pediatric population.

Method

5 medical students were trained in general ultrasound techniques over a 2-week period through a 1 hour lecture followed by hands on practice with student averages of 2.4 aorta, 4.4 IVC (inferior vena cava) and 6.8 cardiac practice scans verified by a fellowship trained physician during the training period.

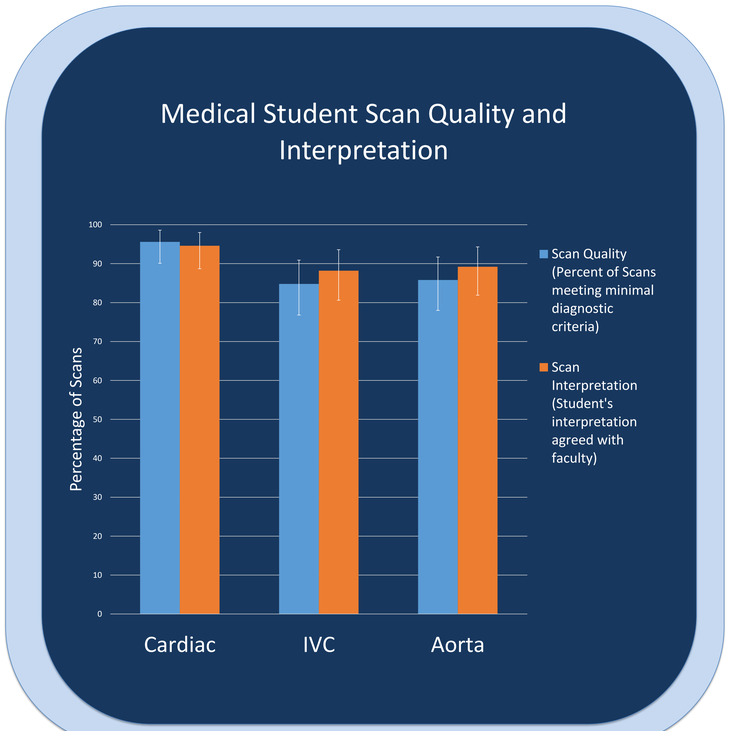
Students staffed a pediatric emergency department 24 hours a day for 5 weeks in 12 hour shifts.

The medical students identified euvolemic patients between ages 0-13 and obtained written consent for 135 patients. The medical students collected ultrasound images of the IVC, aorta, and heart with a parasternal long view and apical view of each patient. The medical students estimated left ventricular ejection fraction, then measured IVC diameter and aorta diameter.

Each scan was reviewed for quality of image acquisition and accuracy of interpretation by an ultrasound fellowship trained emergency medicine physician and reviewed by a second faculty if the first disagreed with the student's interpretation. Quality of the scans were graded on the American College of Emergency Physicians' 5-point quality assurance grading scale with a score of 3 or above meeting minimum criteria for diagnosis.

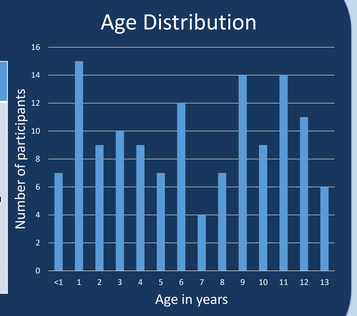
Results

- A total of 135 patients, 64 females (47%) and 71 males (53%), ages 1 week to 13 years were enrolled in the study.
- Complete studies were available for 115 cardiac scans, 112 IVC scans and 113 aorta scans.
- Ultrasound fellowship trained faculty scored 110 of the 115 cardiac scans 3 or above on 95.6% (95% CI 90.1-98.6%) of the scans and agreed with the medical student's interpretation at 94.6% (106/112; 95% CI 88.7-98.0%).
- Faculty scored 95 of 112 IVC scans as a 3 or above on 84.8% (95% CI 76.8-90.9%) and agreed with the medical student's interpretation at 88.2% (97/110; 95% CI 80.6-93.6%).
- Faculty scored the aorta scans as a 3 or above on 85.8% (97/113; 95% CI 78.0-91.7%) of the scans and agreed with the medical student's interpretation at 89.2% (99/111; 95% CI 81.9-94.3%).



Scan Quality Grading Criteria

1	2	3	4	5
No recognizable structure, no objective data can be gathered	Minimally recognizable structures but insufficient for diagnosis	Minimal criteria met for diagnosis, recognizable structures but with some technical or other flaws	Minimal criteria met for diagnosis, all structures imaged well and diagnosis easily supported	Minimal criteria met for diagnosis, all structures imaged with excellent image quality and diagnosis completely supported



Conclusions

Medical students with minimal training can accurately perform ultrasound examinations and accurately detect IVC collapsibility, measure aortic size and assess cardiac contractility in euvolemic pediatric patients

References

- Michalke JA. An overview of emergency ultrasound in the United States. World J Emerg Med. 2012;3(2):85-90.
- Fox JC, Cusick S, Scruggs W, et al. Educational assessment of medical student rotation in emergency ultrasound. *West J Emerg Med.* 2007;8(3):84-87.
- Davis JJ, Wessner CE, Potts J, Au AK, Pohl CA, Fields JM. Ultrasonography in Undergraduate Medical Education: A Systematic Review. *J Ultrasound Med.* 2018;37(11):2667-2679.
- Long E, Oakley E, Duke T, Babl FE, Paediatric Research in Emergency Departments International C. Does Respiratory Variation in Inferior Vena Cava Diameter Predict Fluid Responsiveness: A Systematic Review and Meta-Analysis. *Shock.* 2017;47(5):550-559.
- Gunst M, Ghaemmaghami V, Sperry J, et al. Accuracy of cardiac function and volume status estimates using the bedside echocardiographic assessment in trauma/critical care. *J Trauma.* 2008;65(3):509-516.
- Longjohn M, Wan J, Joshi V, Pershad J. Point-of-care echocardiography by pediatric emergency physicians. *Pediatr Emerg Care.* 2011;27(8):693-696.