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Ultrasound Research Symposium

Sept 20, 4:30 PM – 6:00 PM

Disclosure Statement
9/20/21

Dr. Aarti Sarwal is a consultant for Lungpacer Inc. In addition, she receives other financial or material support from the Society of Critical Care Medicine, Neurocritical Care Society and the American Association of Physical Therapy.

Dr. Noreen Kelly is on the speaker's bureau for Abbott Labs.

All conflicts have been mitigated.

None of the other presenters, planning committee members or staff have any relevant conflicts.

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Ultrasound Research Symposium

Sept 20, 4:30 PM – 6:00 PM

Ultrasound: The Sounds of Innovation, Education, and Research

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PATIENT CARE & SAFETY

RESEARCH

EDUCATION

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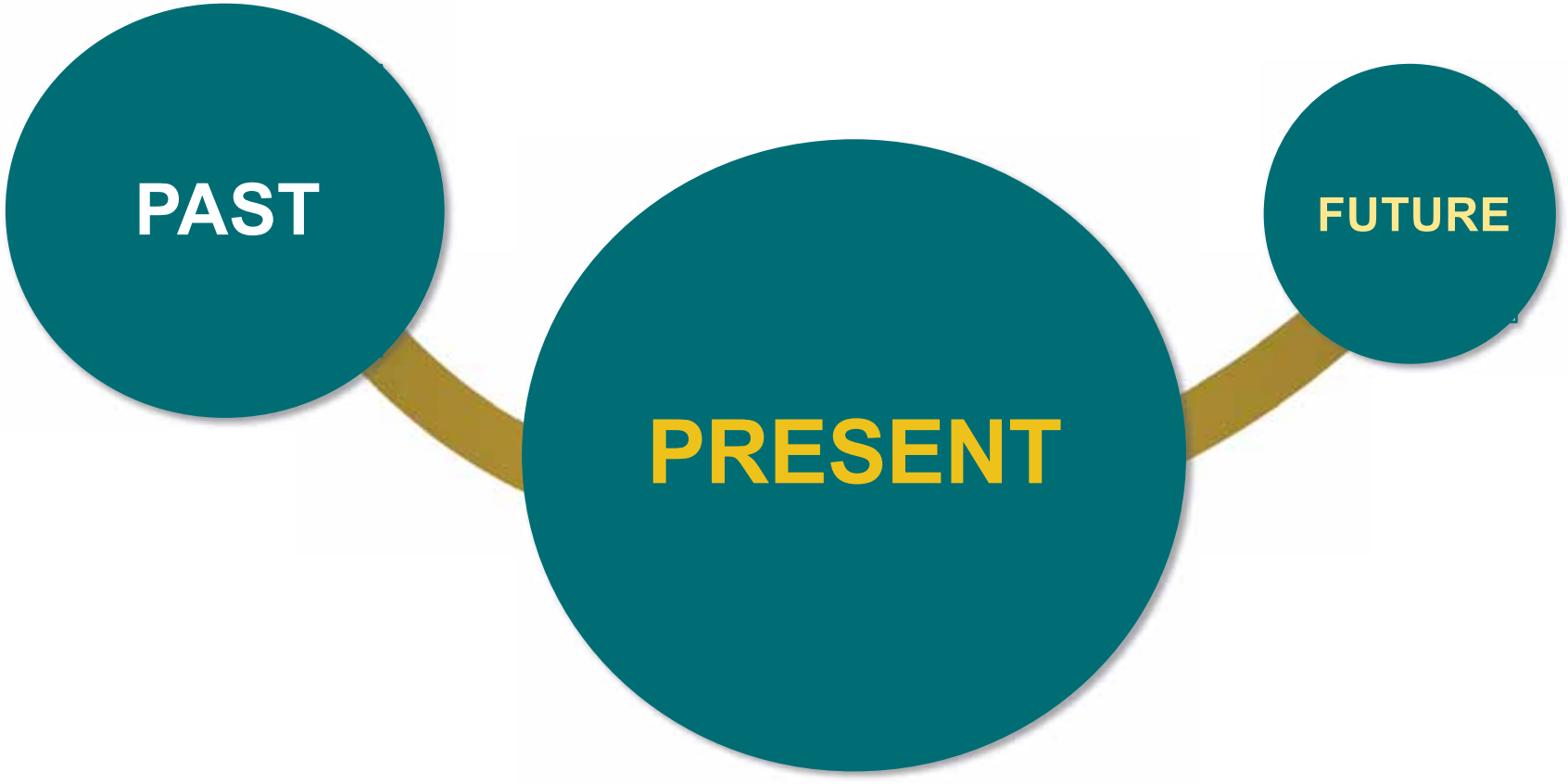
PAST
PRESENT
FUTURE

Vivek Tayal, MD FACEP, FAIUM

Professor of Emergency Medicine

Chief of the Division of Emergency Medicine Point-of-Care Ultrasound

Department of Emergency Medicine

Carolinas Medical Center at Atrium Health

- Chairman, Research Director, and Ultrasound Director of the Department of Emergency Medicine at Wilford Hall Medical Center, San Antonio, Texas
- ACEP Emergency Ultrasound Section Chair
- ABEM Clinical Ultrasonography Task Force
- AIUM Board Member
- Chair of the Clinical Ultrasound Accreditation Program
- 50+ referred articles, letters and chapters, including the majority of ultrasound guidelines and policies in Emergency Medicine and the ultrasound management textbook
- NCCEP President
- Director of Quality Assessment for CMC EM
- Reviewer for 10 national medical journals

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Wake Forest Baptist Health

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Wake Forest School of Medicine

Ultrasound at Legacy Atrium

The Sounds of Innovation, Education and Research

Vivek Tayal, MD, FACEP, FAIUM

History of Clinical Ultrasound Leadership and Support at WF and CMC





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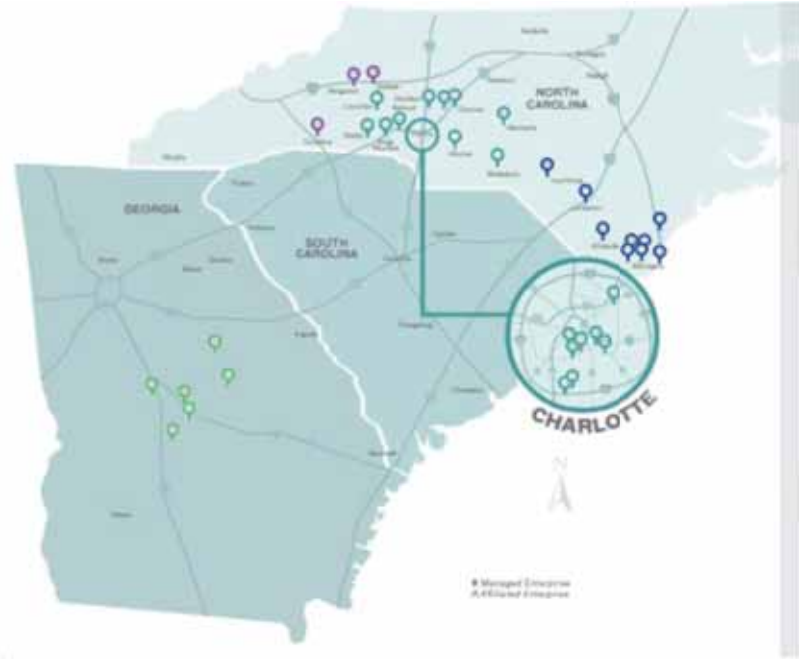
Ultrasound in Clinical Medicine in Atrium Legacy



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US Across the Spectrum

- Traditional Imaging
- Clinical Specialties
- Empowering the clinician at the bedside
- Complementary but not replacement of physical examination
- Uses in Clinical Medicine

Figure 1. ACEP 2016 Emergency US Guidelines Scope of Practice

Resusitative	Diagnostic	Procedural Guidance	Symptom or Sign-Based	Therapeutic

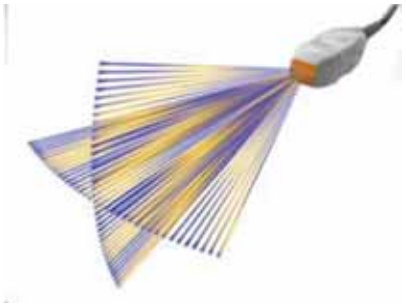
Clinical Use

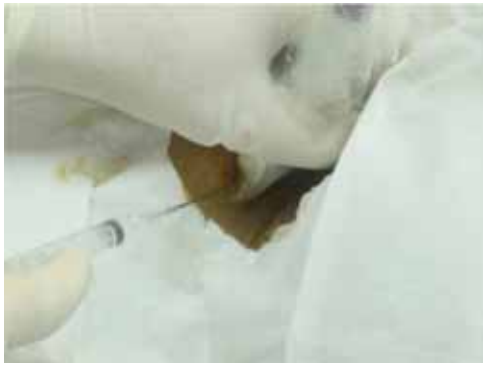
Medical Specialists

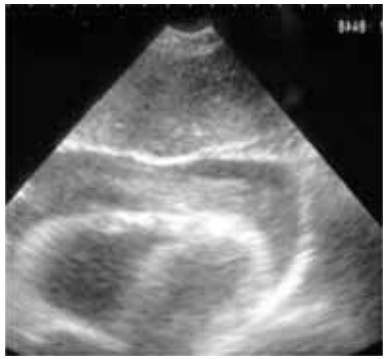
Addiction psychiatrist
Adolescent medicine specialist
Allergist (immunologist)
Anesthesiologist
Cardiac electrophysiologist
Cardiologist
Cardiovascular surgeon
Colon and rectal surgeon
Critical care medicine specialist
Dermatologist
Developmental pediatrician
Diagnostic radiologist
Emergency medicine specialist
Endocrinologist
Family medicine physician
Forensic pathologist
Gastroenterologist
General practitioner
Geriatric medicine specialist
Gynecologist
Gynecologic oncologist
Hand surgeon
Hematologist
Hepatologist
Hospitalist
Hyperbaric physician
Infectious disease specialist
Internist
Interventional cardiologist
Medical examiner
Medical geneticist
Medical oncologist

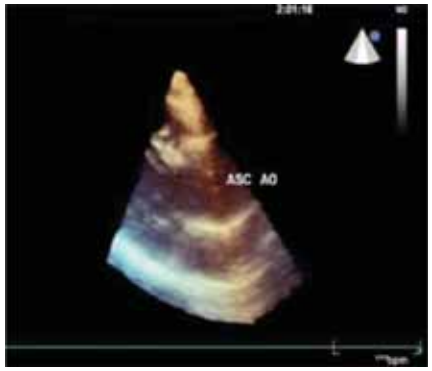
Neonatologist
Nephrologist
Neurological surgeon
Neurologist
Nuclear medicine specialist
Obstetrician
Occupational medicine specialist
Ophthalmologist
Oral surgeon (maxillofacial surgeon)
Orthopedic surgeon
Osteopath
Otolaryngologist
Pain management specialist
Pathologist
Pediatrician
Perinatologist
Physiatrist
Plastic surgeon
Preventive medicine specialist
Psychiatrist
Pulmonologist
Radiation oncologist
Radiologist
Reproductive endocrinologist
Rheumatologist
Sleep disorders specialist
Spinal cord injury specialist
Sports medicine specialist
Surgeon
Thoracic surgeon
Urologist
Vascular surgeon

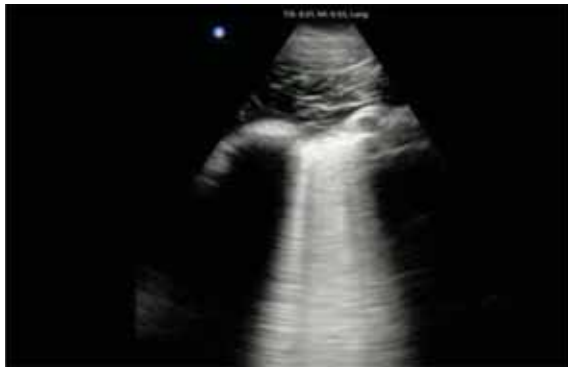
Transition During the Last 25 Years











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US System Leaders – Established Imaging Specialties

CharlotteRadiology




Atrium Health
Sanger Heart & Vascular Institute








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US System Leaders – Emergency Ultrasound - Charlotte area POC






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US System Leaders – "Across the Enterprise"















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Innovation Leaders

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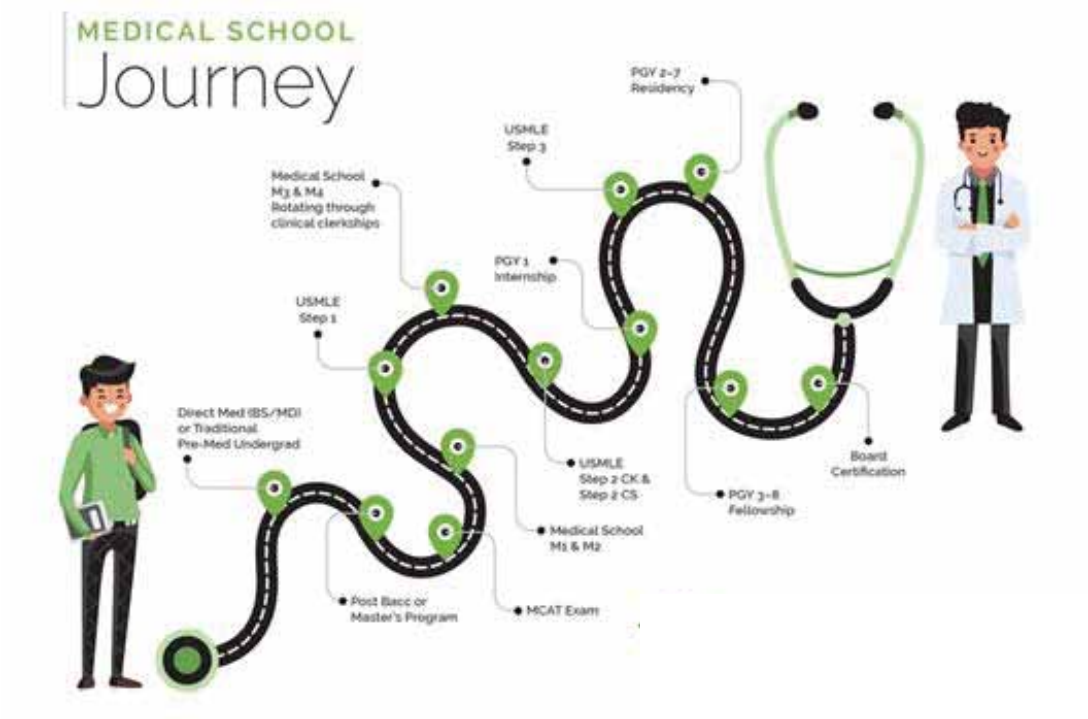
Clinical US Milestones

- 1990s – increased use by Obstetrics and EM
- 1996 – EM established 1st POC US program outside of traditional imaging
- 1997 – Residency training
- 1998 – POC US research -1st paper
- 2001- US Credentialing
- 2005 – US fellowship (post-graduate) established at CMC
- 2006- US workflow software -1st in USA
- 2009 – System-wide credentialing in EM and other clinical specialties
- 2012 – Annual CME courses within Legacy Atrium
- 2013 – CLIC Medical School Curriculum with UNC with embedded US curriculum
- 2015- CMC Dept of EM receives national ED US Program Accreditation through CUAP
- 2016 – Multicenter EM Research Study on PE created by Anthony Weekes, MD
- 2018 – AHQR Grant R01 for multicenter Pulmonary Embolism Study
- 2018 – US Program Management textbook(edit. V. Tayal, Foster, Blaivas) published.
- 2005-2020 – Training for Nurses, Medics, Physicians, and Military Teams
- 2021- US Fellowship Accreditation pending through ABEM/ABMS/ EUFAC

US Education at CMC

- Medical School
- Residency
- Fellowship
- Preceptorships
- Nursing
- Medics
- Military surgical teams



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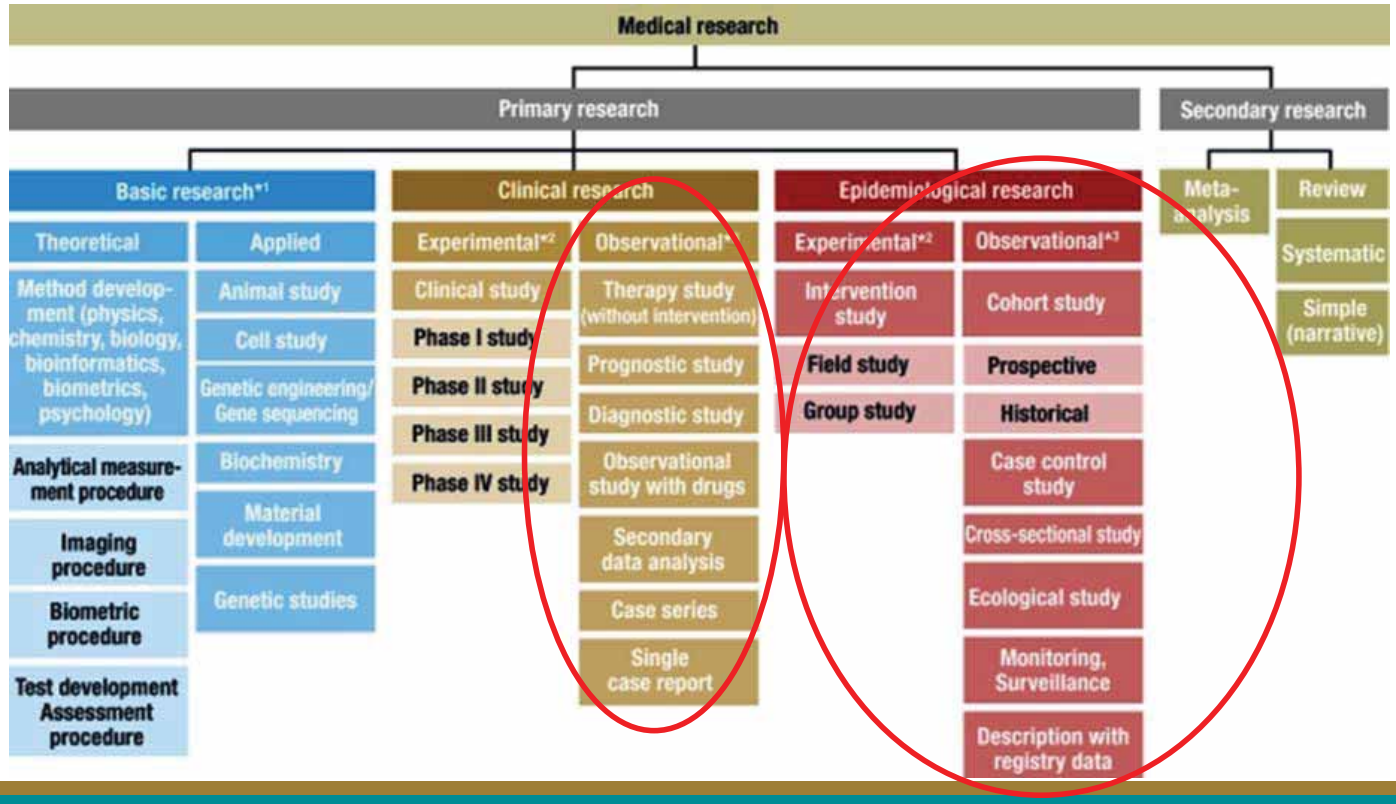
US Research



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CMC Scholarship - Depth and Breadth

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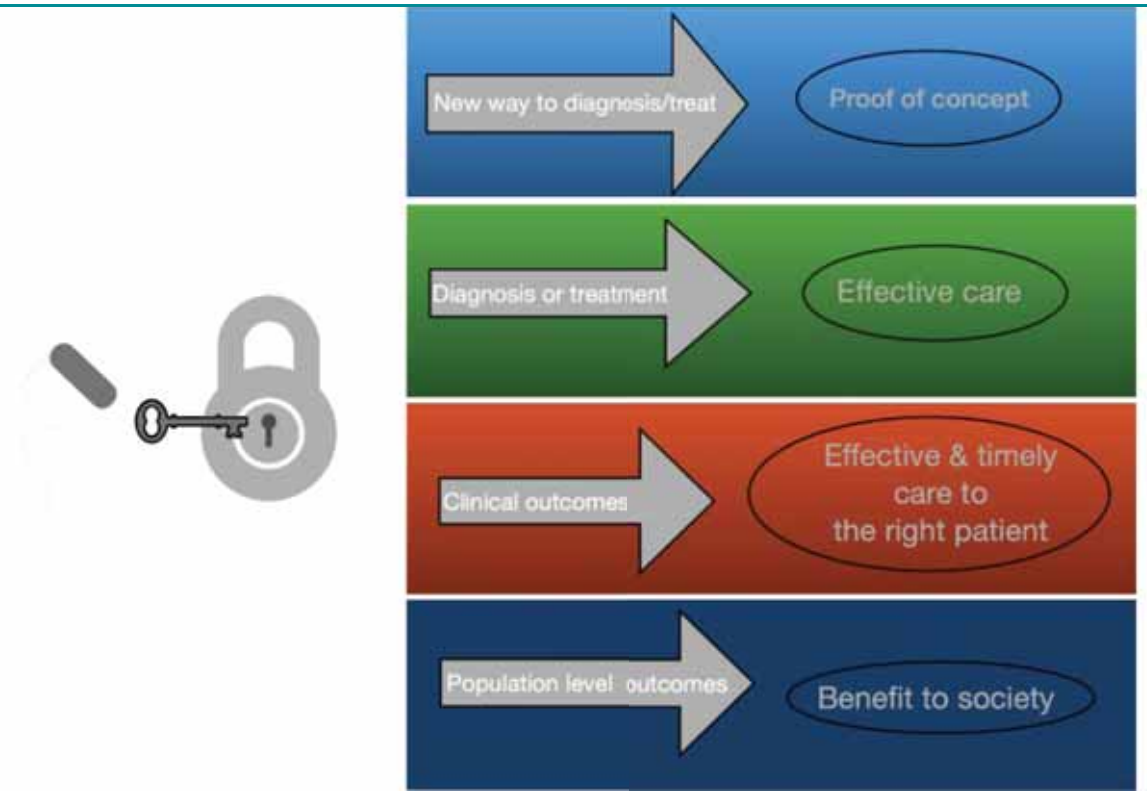
Translation of Ultrasound to Practice



Courtesy of Anthony Weekes ,MD

Family Descent - Atrium and WF

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Collaboration

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Wake Forest® Baptist Health

Casey Glass, MD

Associate Professor of Emergency Medicine

Director of Ultrasound Education, CEAL

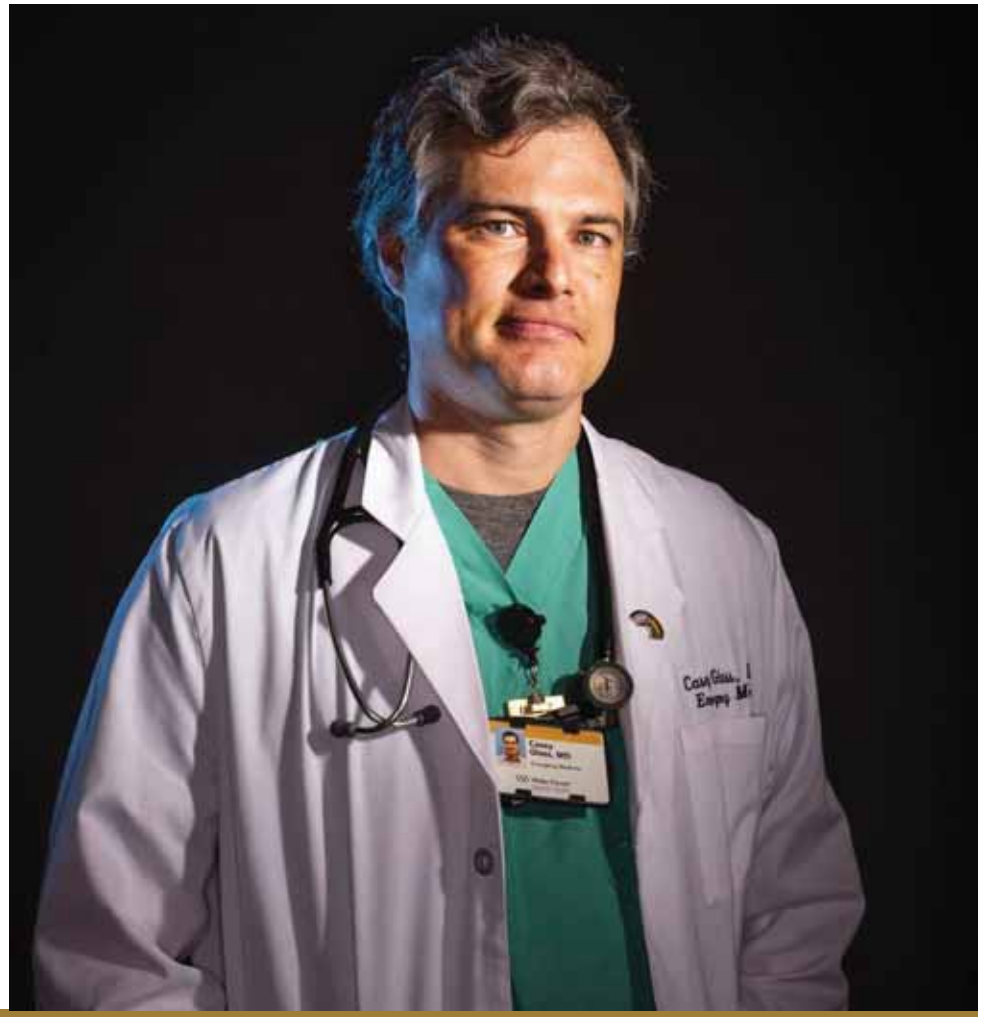
Course Director, Ultrasound Integrated Curriculum

Advanced Emergency Medicine Ultrasound Fellowship Program Director

Department of Emergency Medicine

Atrium Health Wake Forest Baptist

- 15 years of teaching ultrasound at Wake Forest
- Ultrasound Mini-Fellowship Director
- Assistant and Emergency Ultrasound Director
- Assistant Residency Program Director



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Ultrasound in the Enterprise


UND ANATOMY R
X-RAY
CROSS SECTION
REFERENCE


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Ultrasound Everywhere

- Ultrasound Integrated Curriculum
- PA Studies Program
- Clinical Bedside Ultrasound Programs
  - Emergency Medicine
  - Critical Care Service Line
  - Neonatal ICU
  - Internal Medicine / Hospitalist
  - Family and Community Medicine
  - Anesthesia
- Allied Health
- Ultrasound CME Provider

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12,000

Learner Encounters

FY20-21

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Ultrasound IV Training

Center for Experiential and Applied Learning

Wake Forest® School of Medicine

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Enterprise-wide Ultrasound IV Training

Flipped Classroom with Direct Observation Lab

Online Lecture

- Machine Use
- Ultrasound Safety
- Infection Control
- In-plane needle guidance
- Out of Plane Needle Guidance

Skills Lab

- Knobology
- Needle Manipulation basics
- US IV procedure details
- In-plane and Out of plane practice

Assessment

- 10 observed successful IV placements in phantoms

Bedside Application

- Unit Specific
- Flexible to comply with hospital bylaws
- Nurse leadership driven

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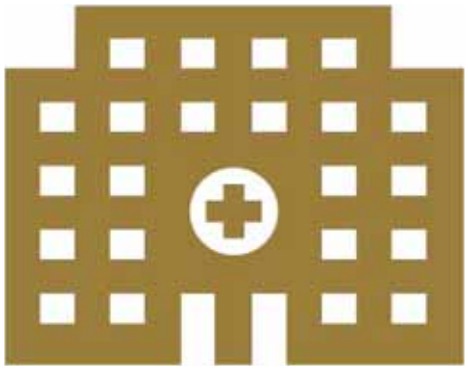
364 Participants

105 Sessions



5 Hospital Campuses

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Comfort with US IV (Comfortable, Very Comfortable)

15% → **50%**

Has participated in Successful US IV in last month

26% → **62%**

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Acknowledgements

Bridget Francis, RDMS

Staff Sonographer

Center for Experiential and Applied Learning

JaNae Joyner, Ph.D.

Associate Vice President & Assistant Dean

Curriculum Experience & Support

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Butterflies in my brain

Neuroultrasound: Innovation, Education, and Research

Department of Neurology

Introduction: Ultrasound credentials

- Aarti Sarwal, MD , FAAN, FNCS, FCCM, FANA, RPNI
- Professor, Neurology
- Section Head & Medical Director, Neurocritical Care
- Co-Director, Ultrasound Curriculum, WFSOM
- Assistant Director, POCUS MSIV Elective, WFSOM
- Course Director, Neurovascular Ultrasound Course, WFSOM
- Course faculty/speaker CME courses/Annual Congress
  - Neurocritical Care Society
  - American Thoracic Society
  - Society of Ultrasound in Medical Education
  - American Association of Physical Therapy
  - World Interactive Network Focused on Critical Ultrasound- WINFOCUS
  - Society of Critical Care Medicine
  - American Society of Neuroimaging
  - Critical Care Symposium, Manchester, UK
  - Indian Society of Critical Care Medicine
- Board of Directors, American Society of Neuroimaging –Neurovascular ultrasound

ΑΩΑ 1902 Alpha Omega Alpha Honor Medical Society

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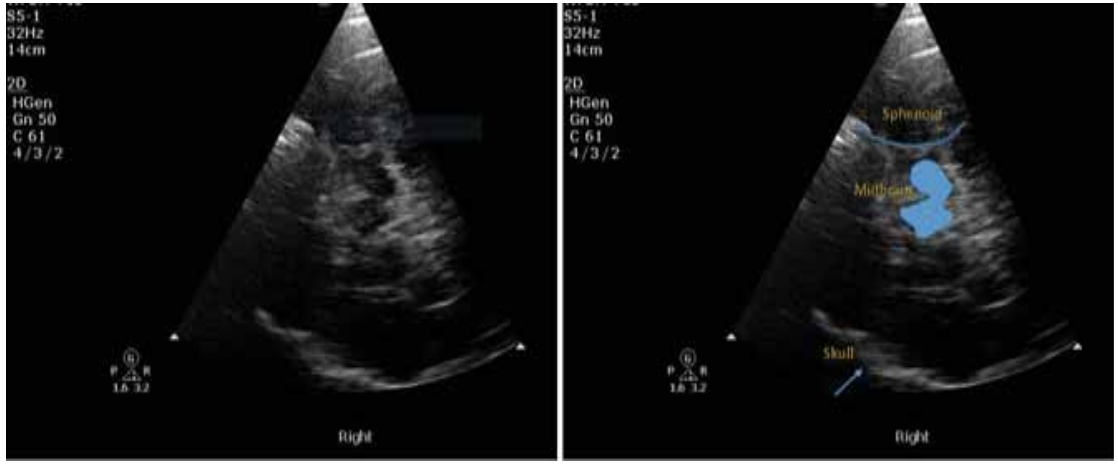
Innovation



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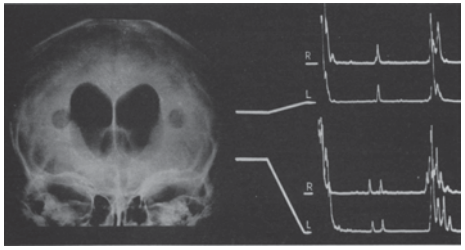
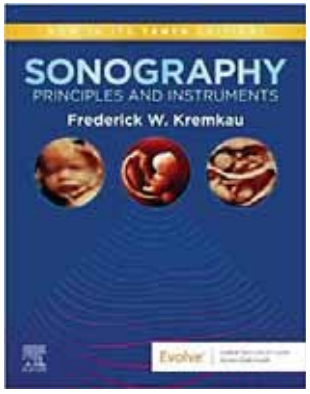
History

- William M. McKinney Frontier Neurosonologist
- Wake Forest is the world's first Center for Medical Ultrasound established in 1963 -Ward A. Riley Ultrasound Center
- Dr. Ward Arthur Riley Jr- Pioneer for the use of B-mode ultrasound carotid
- Fredrick Kremkau – gold standard textbook in Ultrasound physics





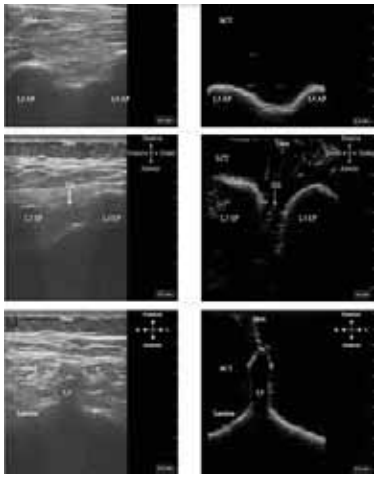
Neurocrit Care (2019) 31:550–558
https://doi.org/10.1007/s12028-019-00779-4

NEUROCRITICAL CARE SOCIETY

TAKE NOTICE: TECHNOLOGY

Development of a Homemade Spinal Model for Simulation to Teach Ultrasound Guidance for Lumbar Puncture

Madison Odom[1], Jonathan R. Gomez[2*], Kerry Ann Danelson[3] and Aarti Sarwal[2]



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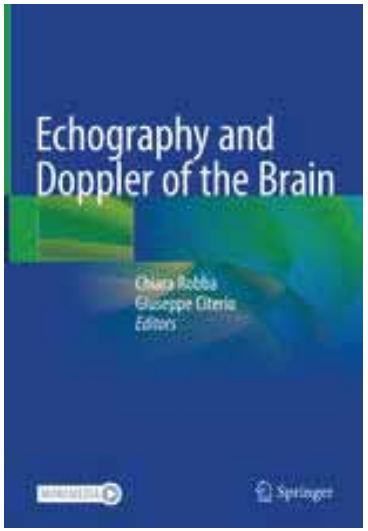
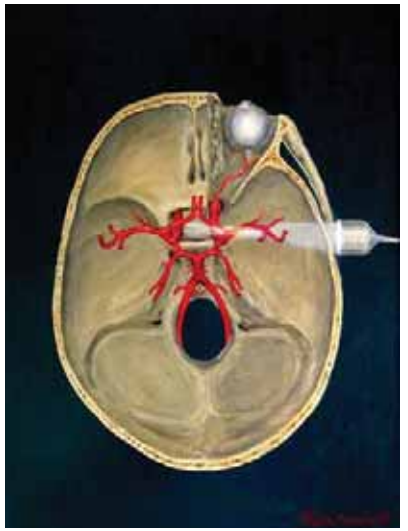
Education





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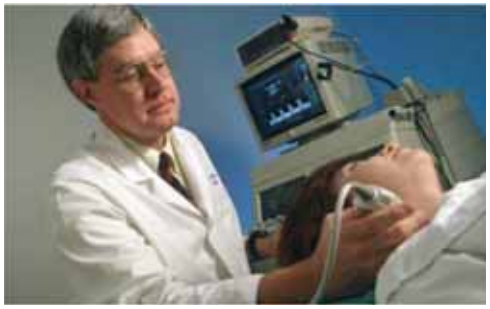
Neurovascular Ultrasound Course

- One week Neurosonology Course twice yearly since 1974 - Dr. William Markley McKinney and One week Neurovascular Interpretation Course yearly since 1992 –Dr. Charles Tegeler
  - >3500 physicians, sonographers & researchers
  - >300 international scholars
- McKinney-Avant Chair in Neurosonology
- Neurosonology Research Fellowship- 10 international and one local scholar
- ASN Neurosonology certification exam


Advanced Ultrasound Seminar June 15 in Winston-Salem. The seminar was part of the celebration of the 10th anniversary of the Center for Medical Ultrasound and the Postgraduate

Annual Fund to reach its goal of $370,000. The Honor Roll of contributors will be published in the October issue of M/A/N.

FELLOWSHIP FUND — Dr. Richard Janeway (left congratulates Dr. William M. McKinney, in whose honor neurosonology fellowship fund was created. It wa



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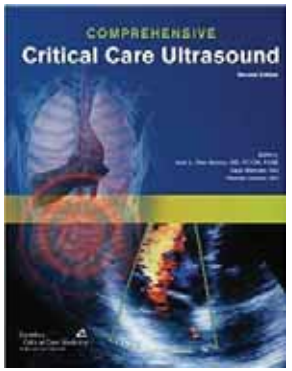
Aarti,
As a personal note, I want to thank you so much for serving as faculty. I know the course would not have been nearly as good without you. You are a tireless educator, and a world expert in critical care ultrasound. Your enthusiasm invigorated not only the attendees, but also the faculty, who all loved learning neuro-ultrasound. You were one of the faculty mentioned by name by attendees approaching me to comment positively on the course faculty. You are one of the best ultrasound/echo teachers I have had the privilege to work with.

Sincerely,

Michael Lanspa, MD, FASE, ATSF
Co-director and Co-chair,
Critical Care Ultrasound and Echocardiography I and II
American Thoracic Society



SECTION III: MONITORING APPLICATIONS

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Education

Intensive Care Med (2019) 45:913–927
https://doi.org/10.1007/s00134-019-05610-4

REVIEW

Brain ultrasonography: methodology, basic and advanced principles and clinical applications. A narrative review

Chiara Robba[1*], Alberto Goffi[2], Thomas Geeraerts[3], Danilo Cardim[4], Gabriele Via[5], Marek Czosnyka[6], Soojin Park[7], Aarti Sarwal[8], Llewellyn Padayachy[9], Frank Rasulo[10] and Giuseppe Citerio[11]

Neurocrit Care (2020) 32:502–511
https://doi.org/10.1007/s12028-019-00766-9

ORIGINAL WORK

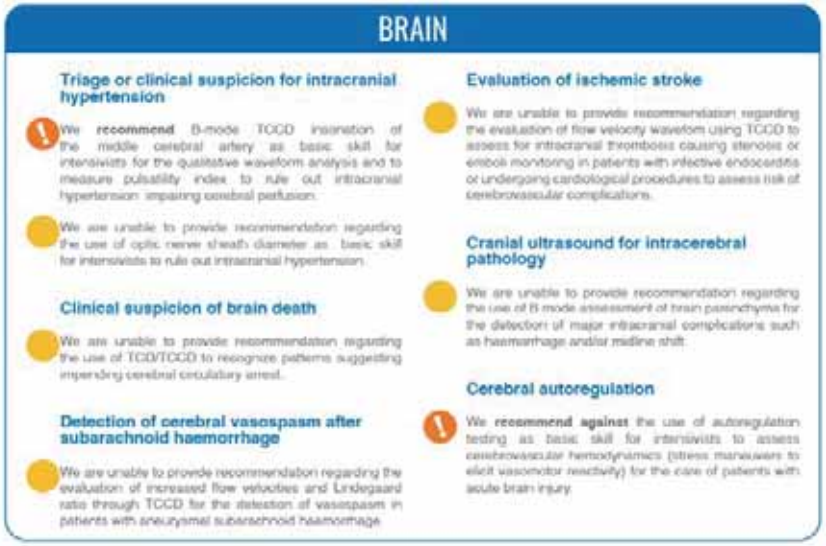
Brain Ultrasonography Consensus on Skill Recommendations and Competence Levels Within the Critical Care Setting

Chiara Robba[1†], Daniele Poole[2†], Giuseppe Citerio[3†], Fabio S. Taccone[4†], Frank A. Rasulo[5*†] and the Consensus on brain ultrasonography in critical care group

Intensive Care Med
https://doi.org/10.1007/s00134-021-06486-z

CONSENSUS AND EXPERT RECOMMENDATION

Basic ultrasound head-to-toe skills for intensivists in the general and neuro intensive care unit population: consensus and expert recommendations of the European Society of Intensive Care Medicine



2021

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Research

THE POINTER NEUROVASCULAR ANCILLARY STUDY

Award Number: R01AG066910
ORGANIZATION: NATIONAL INSTITUTE ON AGING
OPDIV: NIH
AWARD CLASS: DISCRETIONARY
AWARD ACTIVITY TYPE: SCIENTIFIC/HEALTH RESEARCH (INCLUDES SURVEYS)

U.S. Study to Protect Brain Health Through Lifestyle Intervention to Reduce Risk (U.S. POINTER)

CUPID

- **C**ranial **U**ltrasound for **P**oint-of-care **I**ntracranial Hemorrhage **D**iagnosis

ASA-Bugher Center
Brain Bleed Collaborative
Field to Bench Translation Research

WFSM Brain Bleed Collaborative

Wake Forest Baptist Health · GTCC · GTCC EMS Program · Atrium Health

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@aartisarwal

asarwal@wakehealth.edu

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Roots, Fruits and Strategic Direction

Echocardiography in Emergency Medicine

Carolinas Medical Center
Atrium Health Department of
Emergency Medicine

Anthony J Weekes MD MSc

Echocardiography

- Goal Directed, Limited, Comprehensive
- Roots: Early work
- Fruits: Recent work
- Strategy: Next Steps

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Roots: Early work

What can we do?

- Immediate availability
- Immediate interpretation
- Resuscitation & hypotension
- Does it help?
  - Timing to diagnosis
  - Timing to disposition
  - Timing to intervention

Left ventricular systolic function

- Yes, we can
- Visual estimation of LV ejection by EM providers

CLINICAL INVESTIGATIONS

Determination of Left Ventricular Function by Emergency Physician Echocardiography of Hypotensive Patients

CHRISTOPHER L. MOORE, MD, GEOFFREY A. ROSE, MD, VIVEK S. TAYAL, MD, D. MATTHEW SULLIVAN, MD, JAMES A. ARROWOOD, MD, JEFFREY A. KLINE, MD

Abstract. **Objective:** To determine whether emergency physicians (EPs) with goal-directed training can use echocardiography to accurately assess left ventricular function (LVF) in hypotensive emergency department (ED) patients. **Methods:** Prospective, observational study at an urban teaching ED with >100,000 visits/year. Four EP investigators with prior ultrasound experience underwent focused echocardiography training. A convenience sample of 51 adult patients with symptomatic hypotension was enrolled. Exclusion criteria were a history of trauma, chest compressions, or electrocardiogram diagnostic of acute myocardial infarction. A five-view transthoracic echocardiogram was recorded by an EP investigator who estimated ejection fraction (EF) and categorized LVF as normal, depressed, or severely depressed. A blinded cardiologist reviewed all 51 studies for EF, categorization of function, and quality of the study. Twenty randomly selected studies were reviewed by a second cardiologist to determine interobserver variability. **Results:** Comparison of EP vs. primary cardiologist estimate of EF yielded a Pearson's correlation coefficient $R = 0.86$. This compared favorably with interobserver correlation between cardiologists ($R = 0.84$). In categorization of LVF, the weighted agreement between EPs and the primary cardiologist was 84%, with a weighted kappa of 0.61 ($p < 0.001$). Echocardiographic quality was rated by the primary cardiologist as good in 33%, moderate in 43%, and poor in 22%. The EF was significantly lower in patients with a cardiac cause of hypotension vs. other patients (25 ± 10% vs. 48 ± 17%, $p < 0.001$). **Conclusions:** Emergency physicians with focused training in echocardiography can accurately determine LVF in hypotensive patients. **Key words:** echocardiography; ejection fraction; emergency medicine; hypotension; shock; ultrasound. ACADEMIC EMERGENCY MEDICINE 2002; 9:186–193

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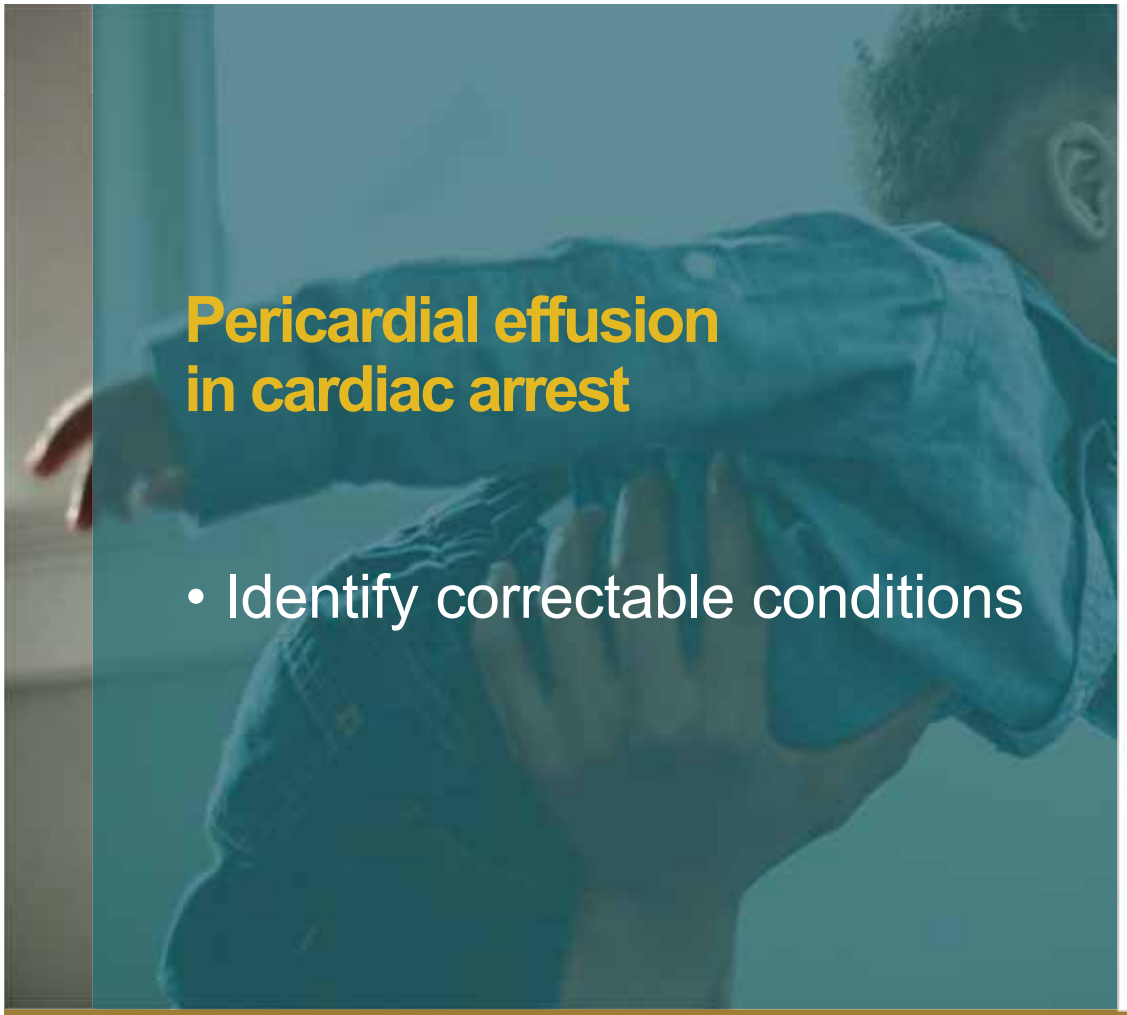

Pericardial effusion in cardiac arrest

- Identify correctable conditions

Emergency echocardiography to detect pericardial effusion in patients in PEA and near-PEA states☆

Vivek S. Tayal*, Jeffrey A. Kline

Department of Emergency Medicine, P.O. Box 32861, Charlotte, NC 28232, USA

Received 28 March 2003; received in revised form 1 July 2003; accepted 1 July 2003

Abstract

Objectives: Emergency echocardiography (EM echo) has been proposed to assist in decision-making in patients with pulseless electric activity (PEA) or PEA-like states. We observed the value of EM echo by emergency physicians in detecting pericardial effusion in patients in PEA and near PEA states. *Materials and methods:* Observational, prospective series at a Level 1 urban ED of patients with non-traumatic PEA or near PEA states who had EM echoes performed by emergency physicians during an 18-month period. Outcomes of patients with EM echoes were established by review of clinical course, formal echocardiography, radiography, operation or autopsy. *Results:* Twenty patients had EM echo for non-traumatic hemodynamic collapse. Eight of 20 patients (40%) were without cardiac ventricular motion and were refractory to ACLS measures. Twelve of 20 (60%) patients had cardiac kinetic motion observed on echo. Eight of the 12 (67%) patients with cardiac motion had a pericardial effusion observed on EM echo. Formal echocardiography or other imaging studies confirmed all pericardial effusion cases. The following diagnoses were subsequently confirmed in patients with pericardial effusion: one aortic aneurysm, two aortic dissections, two metastatic cancers, one post-dialysis effusion, two minimal effusions. Three patients had tamponade with emergency pericardial drainage or surgery. In two of four patients with cardiac activity without pericardial effusion, EM echo was useful by detecting pacer capture and ROSC, respectively. *Conclusions:* Emergency echocardiography performed by emergency physicians in patients in PEA or near PEA states can detect pericardial effusions with correctable etiologies versus true PEA with ventricular standstill.

Keywords: Echocardiography; Emergent; PEA; Pericardial effusion; Ultrasound; Cardiac

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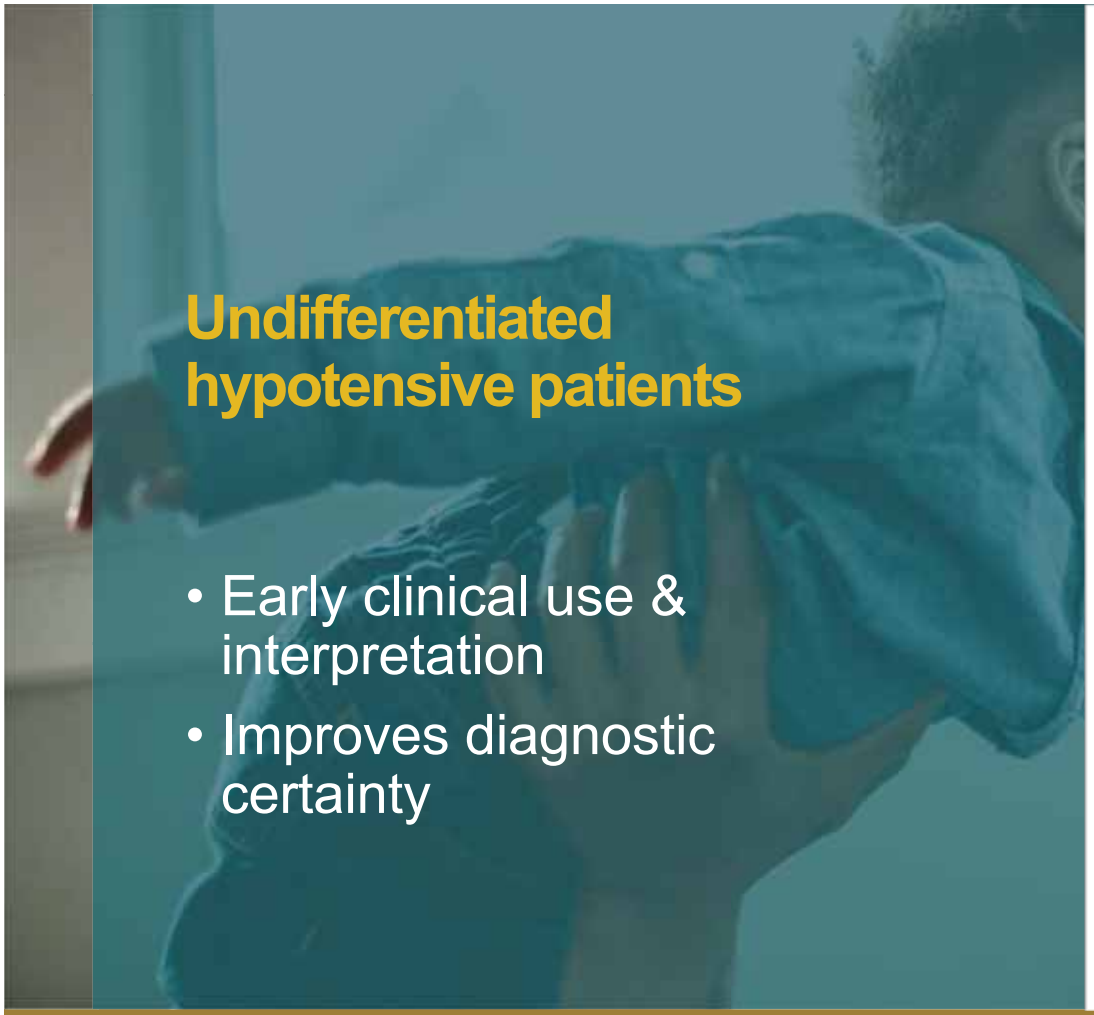

Undifferentiated hypotensive patients

- Early clinical use & interpretation
- Improves diagnostic certainty

Randomized, controlled trial of immediate versus delayed goal-directed ultrasound to identify the cause of nontraumatic hypotension in emergency department patients*

Alan E. Jones, MD; Vivek S. Tayal, MD; D. Matthew Sullivan, MD; Jeffrey A. Kline, MD

Objective: We examined a physician-performed, goal-directed ultrasound protocol for the emergency department management of nontraumatic, symptomatic, undifferentiated hypotension.

Design: Randomized, controlled trial of immediate vs. delayed ultrasound.

Setting: Urban, tertiary emergency department, census >100,000.

Patients: Nontrauma emergency department patients, aged >17 yrs, and initial emergency department vital signs consistent with shock (systolic blood pressure <100 mm Hg or shock index >1.0), and agreement of two independent observers for at least one sign and symptom of inadequate tissue perfusion.

Interventions: Group 1 (immediate ultrasound) received standard care plus goal-directed ultrasound at time 0. Group 2 (delayed ultrasound) received standard care for 15 mins and goal-directed ultrasound with standard care between 15 and 30 mins after time 0.

Measurements and Main Results: Outcomes included the number of viable physician diagnoses at 15 mins and the rank of their likelihood of occurrence at both 15 and 30 mins. One hundred eighty-four patients were included. Group 1 (n = 88) had a smaller median number of viable diagnoses at 15 mins (median = 4) than did group 2 (n = 96, median = 9, Mann-Whitney U test, $p < .0001$). Physicians indicated the correct final diagnosis as most likely among their viable diagnosis list at 15 mins in 80% (95% confidence interval, 70–87%) of group 1 subjects vs. 50% (95% confidence interval, 40–60%) in group 2, difference of 30% (95% confidence interval, 16–42%).

Conclusions: Incorporation of a goal-directed ultrasound protocol in the evaluation of nontraumatic, symptomatic, undifferentiated hypotension in adult patients results in fewer viable diagnostic etiologies and a more accurate physician impression of final diagnosis. (Crit Care Med 2004; 32:1703–1708)

Key Words: hypotension; shock; ultrasound; diagnosis; mortality; clinical trial

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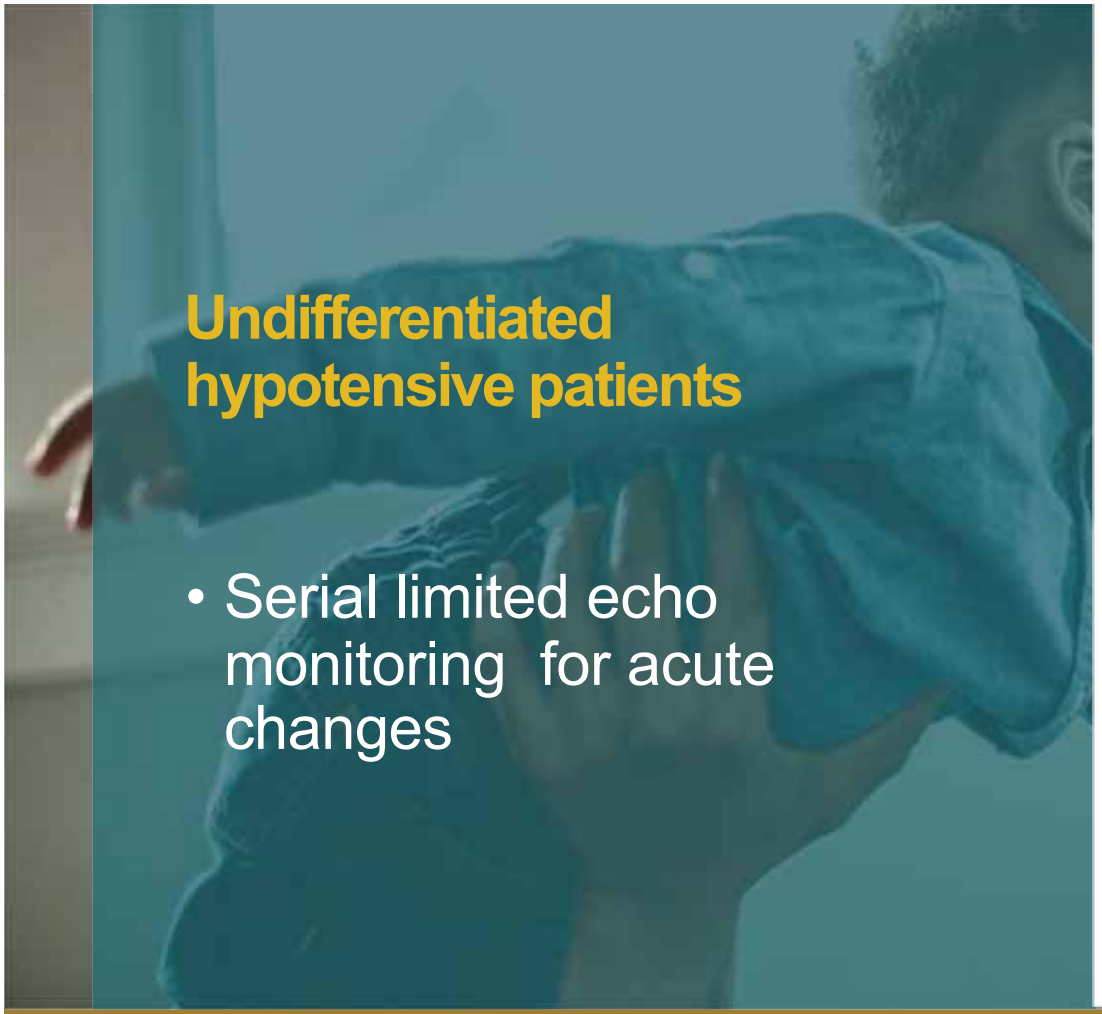
Fruits: Recent work

What can we do better?

- Immediate clinical usefulness
- Critically ill
- What are we doing?
- Close monitoring
- Does it help?
  - Detecting acute changes
    - In response to interventions
  - Quantifying important features



Undifferentiated hypotensive patients

- Serial limited echo monitoring for acute changes

Academic Emergency Medicine
Official Journal of the Society for Academic Emergency Medicine

Comparison of Serial Qualitative and Quantitative Assessments of Caval Index and Left Ventricular Systolic Function During Early Fluid Resuscitation of Hypotensive Emergency Department Patients

Anthony J. Weekes, MD, Heather M. Tassone, DO, Alan Babcock, MD, Dale P. Quirke, MD, H. James Norton, PhD, Krishnaraj Jayarama, DO, and Vivek S. Tayal, MD

Abstract

Objectives: The objective was to determine whether serial bedside visual estimates of left ventricular systolic function (LVF) and respiratory variation of the inferior vena cava (IVC) diameter would agree with quantitative measurements of LVF and caval index in hypotensive emergency department (ED) patients during fluid challenges. The authors hypothesized that there would be moderate inter-rater agreement on the visual estimates.

Methods: This prospective observational study was performed at an urban, regional ED. Patients were eligible for enrollment if they were hypotensive in the ED as defined by a systolic blood pressure (sBP) of <100 mm Hg or mean arterial pressure of ≤65 mm Hg, exhibited signs or symptoms of shock, and the treating physician intended to administer intravenous (IV) fluid boluses for resuscitation. Sonologists performed a sequence of echocardiographic assessments at the beginning, during, and toward the end of fluid challenge. Both caval index and LVF were determined by the sonologist in qualitative then quantitative manners. Deidentified digital video clips of two-dimensional IVC and LVF assessments were later presented, in random order, to an ultrasound (US) fellowship-trained emergency physician using a standardized rating system for review. Statistical analysis included both descriptive statistics and correlation analysis.

Results: Twenty-four patients were enrolled and yielded 72 caval index and LVF videos that were scored at the bedside prior to any measurements and then reviewed later. Visual estimates of caval index compared to measured caval index yielded a correlation of 0.81 ($p < 0.0001$). Visual estimates of LVF compared to fractional shortening yielded a correlation of 0.84 ($p < 0.0001$). Inter-rater agreement of respiratory variation of IVC diameter and LVF scores had simple kappa values of 0.70 (95% confidence interval [CI] = 0.56 to 0.85) and 0.46 (95% CI = 0.29 to 0.63), respectively. Significant differences in mean values between time 0 and time 2 were found for caval index measurements, the visual scores of IVC diameter variation, and both maximum and minimum IVC diameters.

Conclusions: This study showed that serial visual estimations of the respiratory variation of IVC diameter and LVF agreed with bedside measurements of caval index and LVF during early fluid challenges to symptomatic hypotensive ED patients. There was moderate inter-rater agreement in both visual estimates. In addition, acute volume loading was associated with detectable acute changes in IVC measurements.

ACADEMIC EMERGENCY MEDICINE 2011; 18:912-921 © 2011 by the Society for Academic Emergency Medicine

Collaboration

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Point of care echo during cardiac arrest

Multi-center REASON study

Survival

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

EUROPEAN RESUSCITATION COUNCIL

Clinical paper

Emergency department point-of-care ultrasound in out-of-hospital and in-ED cardiac arrest

Romolo Gaspari, Anthony Weekes, Srikar Adhikari, Vicki E. Noble, Jason T. Nomura, Daniel Theodoro, Michael Woo, Paul Atkinson, David Blehar, Samuel M. Brown, Terrell Caffery, Emily Douglass, Jacqueline Fraser, Christine Haines, Samuel Lam, Michael Lanspa, Margaret Lewis, Otto Liebmann, Alexander Limkakeng, Fernando Lopez, Elke Platz, Michelle Mendoza, Hal Minnigan, Christopher Moore, Joseph Novik, Louise Rang, Will Scruggs, Christopher Raio

Incorporation in Resuscitation

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

EUROPEAN RESUSCITATION COUNCIL

Clinical paper

A retrospective study of pulseless electrical activity, bedside ultrasound identifies interventions during resuscitation associated with improved survival to hospital admission. A REASON Study

Romolo Gaspari, Anthony Weekes, Srikar Adhikari, Vicki Noble, Jason T. Nomura, Daniel Theodoro, Michael Woo, Paul Atkinson, David Blehar, Samuel Brown, Terrell Caffery, Emily Douglass, Jacqueline Fraser, Christine Haines, Samuel Lam, Michael Lanspa, Margaret Lewis, Otto Liebmann, Alexander Limkakeng, Fernando Lopez, Elke Platz, Michelle Mendoza, Hal Minnigan, Christopher Moore, Joseph Novik, Louise Rang, Will Scruggs, Christopher Raio

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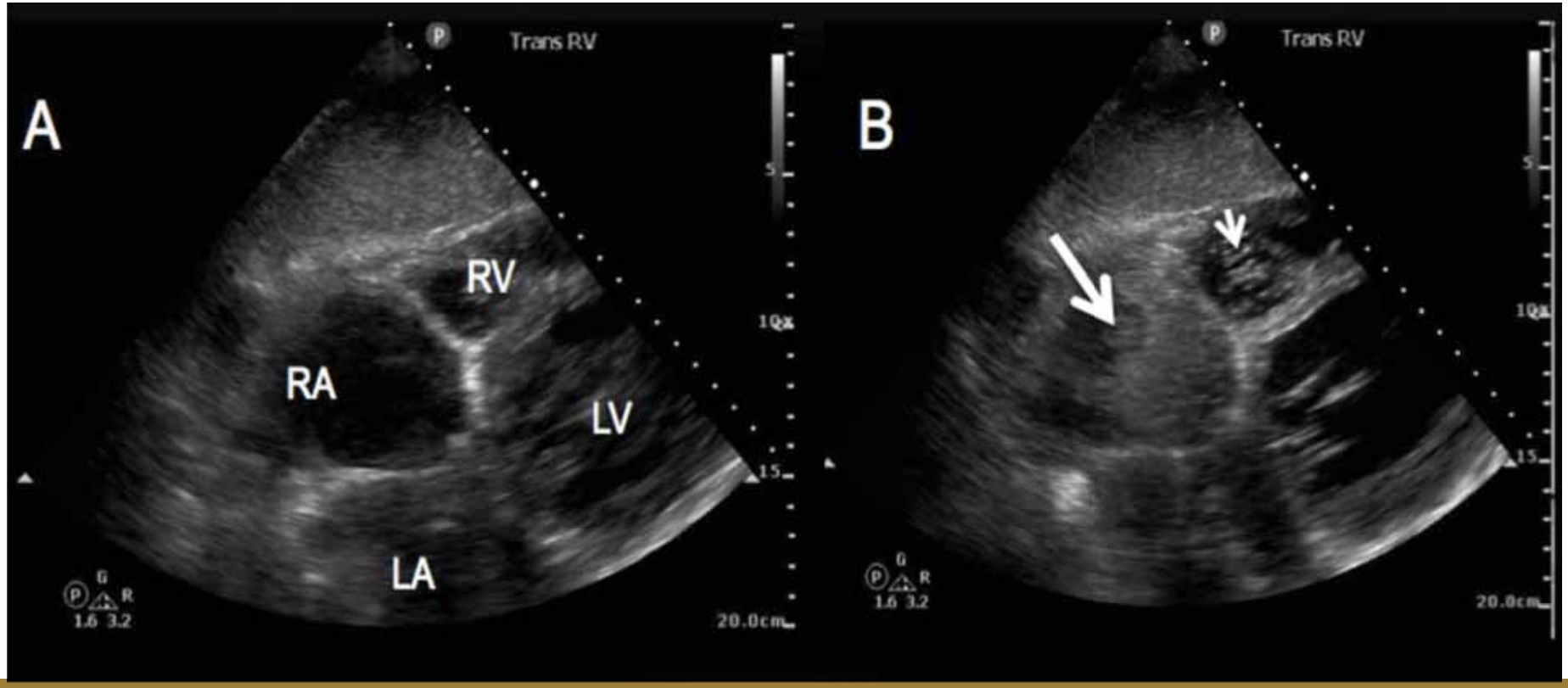
Central venous catheter placement



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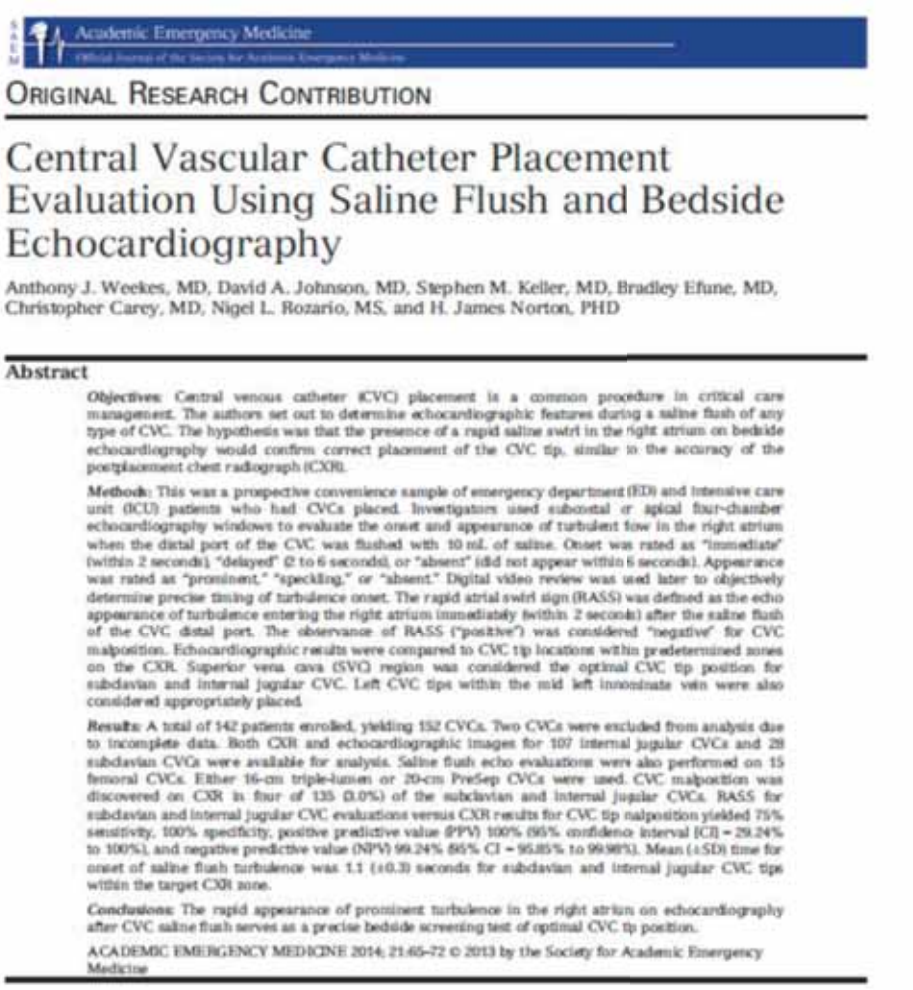
Procedural guidance with limited echocardiography

- Switch to right side of heart
- Focus on safety
- Procedural safety
- Potential impact on practice
  - limit Chest X ray use



Academic Emergency Medicine
Official Journal of the Society for Academic Emergency Medicine

ORIGINAL RESEARCH CONTRIBUTION

Central Vascular Catheter Placement Evaluation Using Saline Flush and Bedside Echocardiography

Anthony J. Weekes, MD, David A. Johnson, MD, Stephen M. Keller, MD, Bradley Efune, MD, Christopher Carey, MD, Nigel L. Rozario, MS, and H. James Norton, PHD

Abstract

Objectives: Central venous catheter (CVC) placement is a common procedure in critical care management. The authors set out to determine echocardiographic features during a saline flush of any type of CVC. The hypothesis was that the presence of a rapid saline swirl in the right atrium on bedside echocardiography would confirm correct placement of the CVC tip, similar to the accuracy of the postplacement chest radiograph (CXR).

Methods: This was a prospective convenience sample of emergency department (ED) and intensive care unit (ICU) patients who had CVCs placed. Investigators used subcostal or apical four-chamber echocardiography windows to evaluate the onset and appearance of turbulent flow in the right atrium when the distal port of the CVC was flushed with 10 mL of saline. Onset was rated as "immediate" (within 2 seconds), "delayed" (2 to 6 seconds), or "absent" (did not appear within 6 seconds). Appearance was rated as "prominent," "speckling," or "absent." Digital video review was used later to objectively determine precise timing of turbulence onset. The rapid atrial swirl sign (RASS) was defined as the echo appearance of turbulence entering the right atrium immediately (within 2 seconds) after the saline flush of the CVC distal port. The observance of RASS ("positive") was considered "negative" for CVC malposition. Echocardiographic results were compared to CVC tip locations within predetermined zones on the CXR. Superior vena cava (SVC) region was considered the optimal CVC tip position for subclavian and internal jugular CVC. Left CVC tips within the mid left innominate vein were also considered appropriately placed.

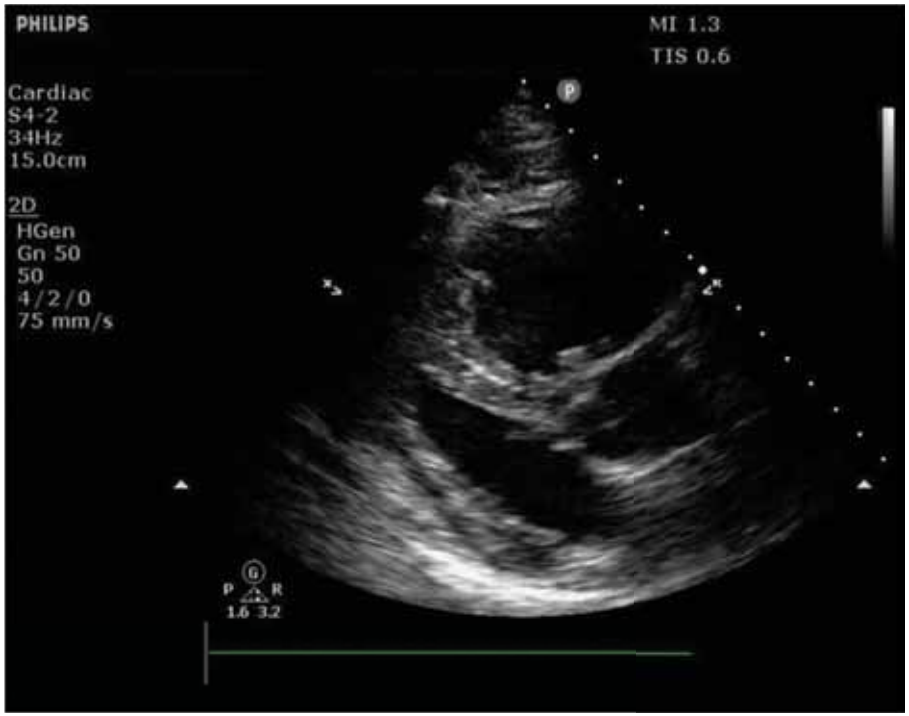
Results: A total of 142 patients enrolled, yielding 152 CVCs. Two CVCs were excluded from analysis due to incomplete data. Both CXR and echocardiographic images for 107 internal jugular CVCs and 28 subclavian CVCs were available for analysis. Saline flush echo evaluations were also performed on 15 femoral CVCs. Either 16-cm triple-lumen or 20-cm PreSep CVCs were used. CVC malposition was discovered on CXR in four of 135 (3.0%) of the subclavian and internal jugular CVCs. RASS for subclavian and internal jugular CVC evaluations versus CXR results for CVC tip malposition yielded 75% sensitivity, 100% specificity, positive predictive value (PPV) 100% (95% confidence interval [CI] = 29.24% to 100%), and negative predictive value (NPV) 99.24% (95% CI = 95.85% to 99.98%). Mean (±SD) time for onset of saline flush turbulence was 1.1 (±0.3) seconds for subclavian and internal jugular CVC tips within the target CXR zone.

Conclusions: The rapid appearance of prominent turbulence in the right atrium on echocardiography after CVC saline flush serves as a precise bedside screening test of optimal CVC tip position.

ACADEMIC EMERGENCY MEDICINE 2014; 21:65–72

Acute right heart conditions

- Pulmonary embolism

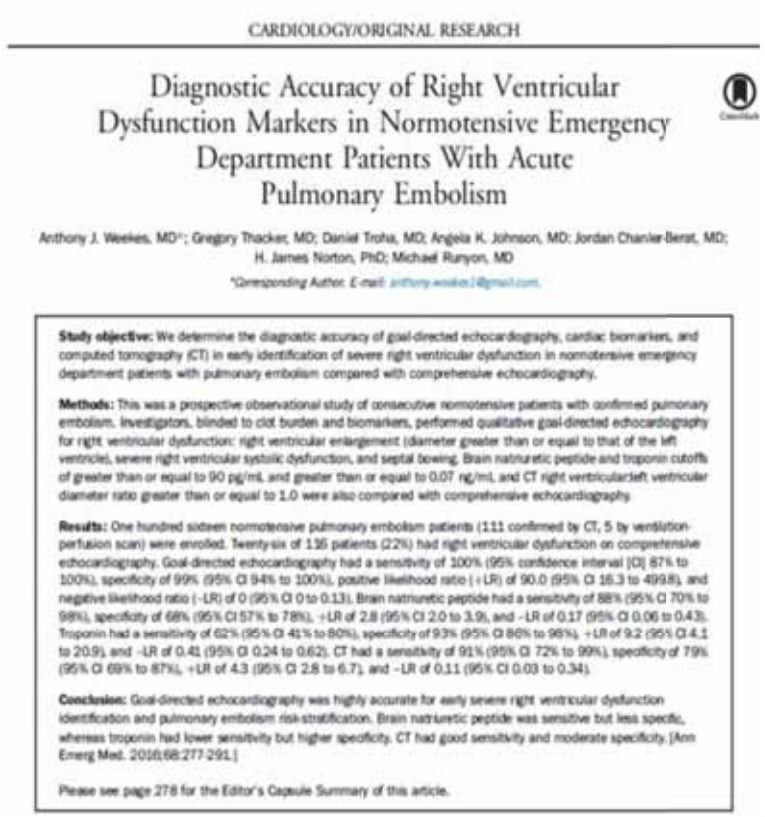


Pulmonary Embolism

Logical steps: Visual assessments to measurements

Stage #1	Stage #2	Stage #3
• GDE • All PE patients • At CMC ED • 24/7 • Diagnostic accuracy • New Outcomes • Inter- and intra-observer agreement	• GDE • All PE at ED • Multiple EDs nationally • Develop prognostic model	• Comprehensive echo • submassive PE patients at Atrium Health EDs • RV focused measurements • Determine RV abnormalities of size function and pressure

Assessing right ventricle in pulmonary embolism



CARDIOLOGY/ORIGINAL RESEARCH

Diagnostic Accuracy of Right Ventricular Dysfunction Markers in Normotensive Emergency Department Patients With Acute Pulmonary Embolism

Anthony J. Weekes, MD*; Gregory Thacker, MD; Daniel Trotta, MD; Angela K. Johnson, MD; Jordan Chanler-Berat, MD; H. James Norton, PhD; Michael Runyon, MD

*Corresponding Author. E-mail: anthony.weekes1@gmail.com.

Study objective: We determine the diagnostic accuracy of goal-directed echocardiography, cardiac biomarkers, and computed tomography (CT) in early identification of severe right ventricular dysfunction in normotensive emergency department patients with pulmonary embolism compared with comprehensive echocardiography.

Methods: This was a prospective observational study of consecutive normotensive patients with confirmed pulmonary embolism. Investigators, blinded to clot burden and biomarkers, performed qualitative goal-directed echocardiography for right ventricular dysfunction: right ventricular enlargement (diameter greater than or equal to that of the left ventricle), severe right ventricular systolic dysfunction, and septal bowing. Brain natriuretic peptide and troponin cutoffs of greater than or equal to 90 pg/mL and greater than or equal to 0.07 ng/mL and CT right ventricular:left ventricular diameter ratio greater than or equal to 1.0 were also compared with comprehensive echocardiography.

Results: One hundred sixteen normotensive pulmonary embolism patients (111 confirmed by CT, 5 by ventilation-perfusion scan) were enrolled. Twenty-six of 116 patients (22%) had right ventricular dysfunction on comprehensive echocardiography. Goal-directed echocardiography had a sensitivity of 100% (95% confidence interval [CI] 87% to 100%), specificity of 99% (95% CI 94% to 100%), positive likelihood ratio (+LR) of 90.0 (95% CI 16.3 to 499.8), and negative likelihood ratio (−LR) of 0 (95% CI 0 to 0.13). Brain natriuretic peptide had a sensitivity of 88% (95% CI 70% to 98%), specificity of 68% (95% CI 57% to 78%), +LR of 2.8 (95% CI 2.0 to 3.9), and −LR of 0.17 (95% CI 0.06 to 0.43). Troponin had a sensitivity of 62% (95% CI 41% to 80%), specificity of 93% (95% CI 86% to 96%), +LR of 9.2 (95% CI 4.1 to 20.9), and −LR of 0.41 (95% CI 0.24 to 0.62). CT had a sensitivity of 91% (95% CI 72% to 99%), specificity of 79% (95% CI 69% to 87%), +LR of 4.3 (95% CI 2.8 to 6.7), and −LR of 0.11 (95% CI 0.03 to 0.34).

Conclusion: Goal-directed echocardiography was highly accurate for early severe right ventricular dysfunction identification and pulmonary embolism risk-stratification. Brain natriuretic peptide was sensitive but less specific, whereas troponin had lower sensitivity but higher specificity. CT had good sensitivity and moderate specificity. [Ann Emerg Med. 2016;68:277-291.]

Please see page 278 for the Editor's Capsule Summary of this article.

ELSEVIER

Original Contribution

PROGNOSTIC VALUE OF RIGHT VENTRICULAR DYSFUNCTION MARKERS FOR SERIOUS ADVERSE EVENTS IN ACUTE NORMOTENSIVE PULMONARY EMBOLISM

Anthony J. Weekes, MD, Angela K. Johnson, MD, Daniel Trotta, MD, Gregory Thacker, MD, Jordan Chanler-Berat, MD, and Michael Runyon, MD

Carolinas Medical Center, Charlotte, North Carolina

Reprint Address: Anthony J. Weekes, MD, Carolinas Medical Center, 1000 Blythe Blvd, Charlotte, NC 28203

□ **Abstract—Background:** Right ventricular dysfunction (RVD) in pulmonary embolism (PE) has been associated with increased morbidity. Tools for RVD identification are not well defined. The prognostic value of RVD markers to predict serious adverse events (SAE) during hospitalization is unclear. **Objective:** Prospectively compare the incidence of SAE in normotensive emergency department patients with PE based upon RVD by goal-directed echocardiography (GDE), cardiac biomarkers, and right-to-left ventricle ratio by computed tomography (CT). Simplified Pulmonary Embolism Severity Index (sPESI) was calculated. Deaths and readmissions within 30 days were recorded. **Methods:** Consecutive normotensive PE patients underwent GDE focused on RVD (RV enlargement, hypokinesis, or septal bowing), serum troponin, and brain natriuretic peptide (BNP), and evaluation of the CT ventricle ratio. In-hospital SAE and complications within 30 days were recorded. **Results:** We enrolled 123 normotensive PE patients (median age 59 years, 49% female). Twenty-six of 123 (26%) patients had one or more SAE. RVD was detected in 24% by GDE, in 39% by biomarkers, and in 38% with CT. In-hospital SAE included one death, six respiratory interventions, six dysrhythmias, three major bleeding episodes, and 21 hypotension episodes. Forty-one percent of patients RVD positive by GDE had SAE, compared to the 18% RVD negative by GDE. Odds ratios for GDE, CT, BNP, troponin, and sPESI for SAE were 3.2 (95% confidence interval [CI] 1.2–8.5), 2.0 (95% CI 0.8–5.1), 3.3 (95% CI 1.3–8.6), 4.2 (95% CI 1.4–13.5), and 2.9 (95% CI 1.1–8.3), respectively. Five patients had non-PE-related deaths within 30 days. **Conclusion:** The incidence of SAE within days of PE was significant in our cohort. Those with RVD had an increased risk of nonmortality SAE.

□ **Key words—pulmonary embolism; prognosis; right ventricle strain; emergency department; echocardiography; ultrasound; risk stratification; adverse outcomes; right ventricle dysfunction**

INTRODUCTION

Background

The ability to diagnose, risk stratify, and initiate treatment in patients with acute pulmonary embolism (PE) is crucial for emergency physicians. One half of all PE cases in the United States are diagnosed in the emergency department (ED), and acute PE has a higher 3-month mortality rate than myocardial infarction (1). Patients with PE and overt signs and symptoms of hypotension and shock have "massive PE" and are at high risk for death and morbidity. The majority of PE cases, however, present without hypotension, and reported morbidity and mortality rates in normotensive PE cohorts vary. Clinical deterioration and death from PE usually involve right ventricular dysfunction (RVD). Occlusion of the pulmonary arteries may lead to increased RV afterload. Increased RV pressures can cause dilatation of the thin-walled RV, leading to RV wall strain, impaired RV

ORIGINAL RESEARCH

Interobserver and Intraobserver Agreement on Qualitative Assessments of Right Ventricular Dysfunction With Echocardiography in Patients With Pulmonary Embolism

Anthony J. Weekes, MD, Laura Ilk, MD, Gregory Thacker MD, Angela K. Johnson, MD, Michael Runyon, MD, Geoffrey Rose, MD, Thomas Johnson, MD, Megan Tompkins, MS, H. James Norton, PhD

Objectives—To evaluate observer agreement using qualitative goal-directed echocardiographic criteria for right ventricular (RV) dysfunction prognostication in submassive pulmonary embolism (PE).

Methods—Two emergency physicians and 2 cardiologists independently reviewed 11 packets of goal-directed echocardiographic video clips consisting of at least 3 windows obtained by emergency physicians from normotensive patients with PE. Nine packets were repeated to assess for intraobserver agreement. Right ventricular dysfunction criteria on goal-directed echocardiography were as follows: RV enlargement was present, with a right-to-left ventricular basal diameter ratio of 1.0 or higher, and flattening of the apex of the RV in 2 or more different windows; RV systolic dysfunction was present if the tricuspid annulus moved toward the apex 10 mm or less and there was RV free wall hypokinesis; and septal deviation was present with any flattening or deviation of the ventricular septum toward the left ventricle.

Results—Among the 4 participants, there was 83.0% agreement on the presence or absence of RV enlargement (κ = 0.66), 74.2% agreement on the presence or absence of RV systolic dysfunction (κ = 0.49), and 71.0% agreement on the presence or absence of septal deviation (κ = 0.38). Intraobserver agreement was 100% for each RV dysfunction variable for each observer (κ = 1.0).

Conclusions—Agreement was substantial for both severe RV enlargement and RV systolic dysfunction and moderate for septal deviation. Right ventricular dysfunction assessment with qualitative goal-directed echocardiographic criteria is reproducible for PE risk stratification.

Key Words—echocardiography; observer agreement; pulmonary embolism; right ventricular dysfunction

Pulmonary embolism (PE) presentations are varied, and clinical management can be challenging. Although up to 5% of PE cases are clinically unstable at the onset, most patients present with normal blood pressure. It is important to identify the patients within this group of normotensive PE presentations that may benefit from closer monitoring for subsequent adverse clinical outcomes and consideration for escalated treatment (eg, thrombolysis) over standard anticoagulation therapy. Goal-directed

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Strategy: Collaboration

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Pulmonary Embolism

Next steps: Early assessments Outcome driven PE research

- 6 academic ED in different states
- Started in 2016
  - AHRQ RO1 funding in 2018
    - 1.3 million over 3 years
- Enrolled1800 patients with PE

Pulmonary Embolism Short-term Clinical Outcomes Risk Estimation

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Suspected or confirmed systemic infection	No 0	Yes +1
GDE showing RV dilation or more	No 0	Yes +1
Abnormal Heart rate <50 or >100, bpm	No 0	Yes +1
CT RV:LV ratio ≥ 1.0	< 1.0 0	Yes +1
Preceding episode syncope	No 0	Yes +1
Creatinine > 2.0 mg/dL	≤ 2.0 0	Yes +2
Medical or social reason for hospitalization	No 0	Yes +1
Systolic BP < 100 mmHg	≥100 0	Yes +1
Dysrhythmia	No 0	Yes +1

COPERR

CLINICAL OUTCOMES IN PULMONARY EMBOLISM RESEARCH REGISTRY

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Collaboration

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More to come

Implementation of a Remote Collaboration Solution to Perform Echocardiograms during the COVID-19 Pandemic

Noreen P. Kelly MD MBA FASE
Director, SHVI Echocardiography Laboratory

Dermot Phelan MD PhD FACC FASE
Director, SHVI Cardiovascular Imaging

Geoffrey A. Rose MD FACC FASE
President, SHVI

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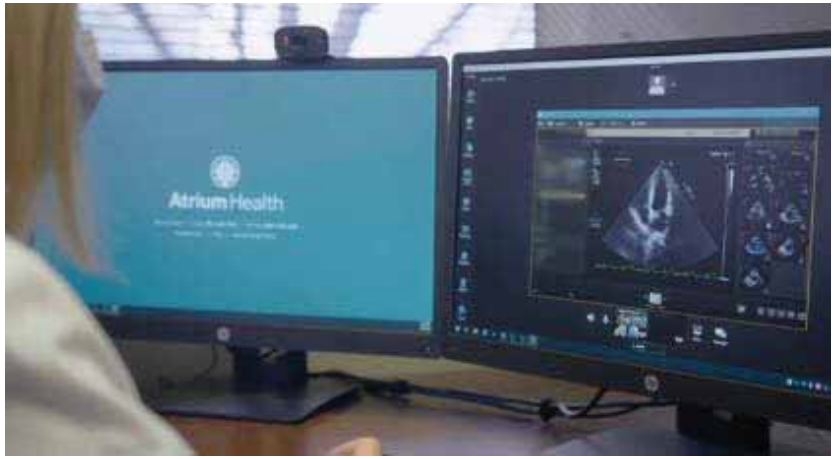
Echocardiography During the COVID-19 Pandemic

Balancing Safety with Optimal Patient Care

- Guidelines emphasized problem-focused examinations with minimum possible scan time
- Employed a remote collaboration solution (Philips Collaboration Live Feature on EPIQ Ultrasound Machines [CL])
- Hypothesized that CL would significantly reduce examination time and image acquisition number, while maintaining diagnostic quality



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The Results

Key Study Results

- 101 limited echocardiograms performed using CL
- All diagnostic
- Statistically significant reduction in examination time and image acquisition number with CL, compared with historical controls
- 42.6% of the CL cohort was COVID+ or PUI, average examination time was 7:59 minutes.

	No-CL Cohort	CL Cohort	
	n (%)	n (%)	p
Duration in Minutes			
Mean (SD)	12.5 (±5.7)	7.1 (±4.4)	<0.0001
Median (Min-Max)	11 (3-28)	6 (2-21)	<0.0001
Number of Images			
Mean (SD)	37.2(±12.8)	30.1 (±12.7)	0.0001
Median (Min-Max)	37 (12-78)	27 (10-83)	<0.0001

Future Directions

Expanding Use of CL Technology

- Continue to serve COVID-19 patients
- Provide consultative services during cardiothoracic surgery and structural heart procedures
- Education and training of satellite echocardiography laboratories

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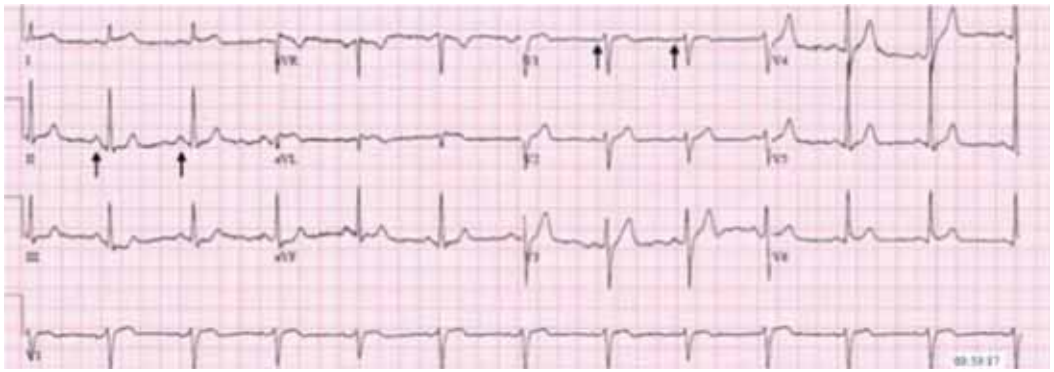
Neuromuscular Ultrasound: Development of a Technology

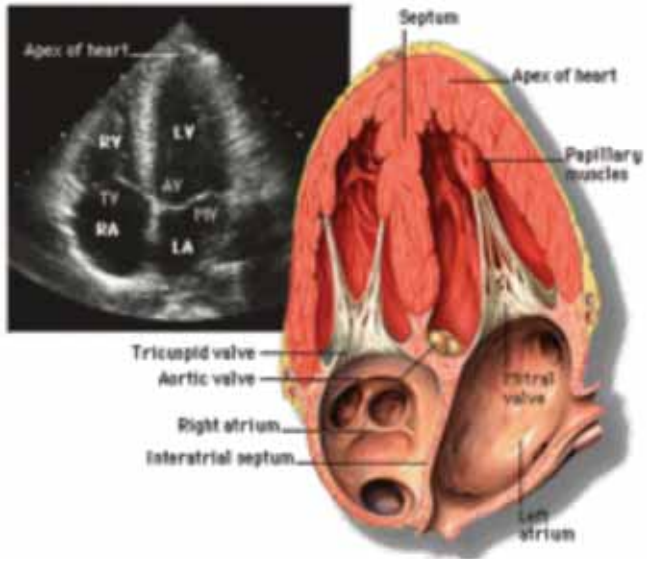
Michael Cartwright, MD, MS
Professor of Neurology

9.20.21 | Department of Neurology

Why Was NMUS Needed?

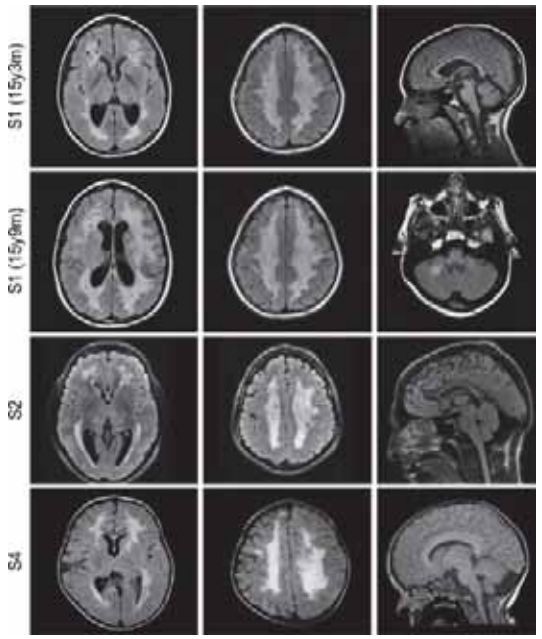
Cardiac evaluation – electrophysiology and imaging





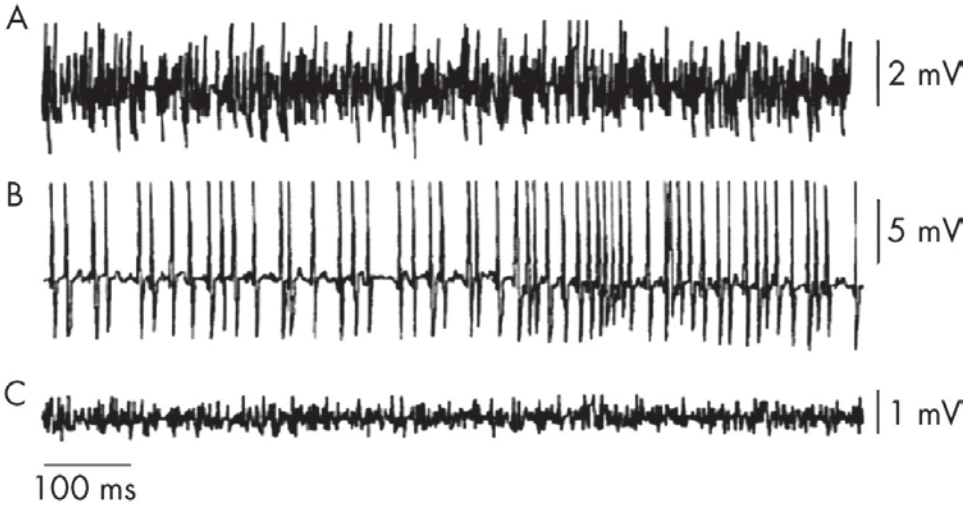
Why Was NMUS Needed?

Seizure evaluation – electrophysiology and imaging



Why Was NMUS Needed?

Nerve evaluation – electrophysiology and NO imaging



?

The Development of NMUS

- 1978 – Muscle imaging in England
- 1988 – Nerve imaging in France
- 1990 – Muscle fasciculations imaged by Dr. Walker at Wake Forest

The Development of NMUS

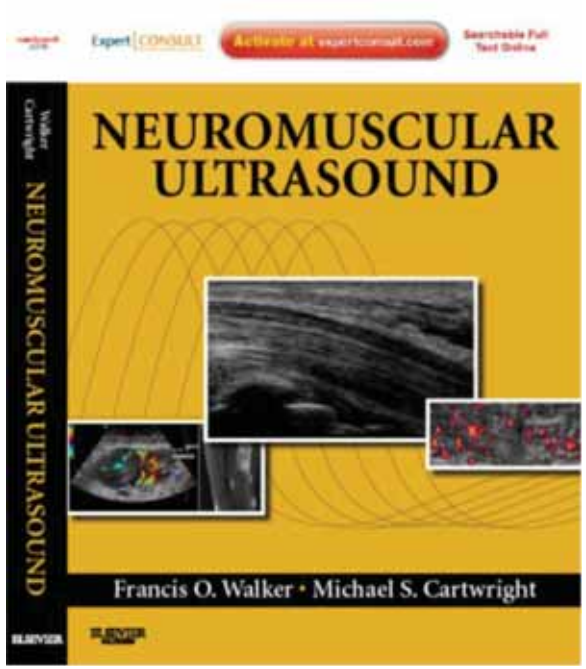
- McKinney + Walker + Technology

The Development of NMUS

- 2002 – AAN Award for NMUS for CTS
- 2004 – First Workshop at AANEM
- 2004 – First Workshop at Wake Forest
- 2006 – Funding from MDA for Reference Values (> 200 citations)
- 2009 – AANEM Position Statement

The Development of NMUS

- 2011 – First Textbook on NMUS



The Development of NMUS

- 2012 – First NMUS Clinical Practice Guideline (> 200 citations, in National Guidelines Clearinghouse)
- 2012 – ISPNI formed in Rome
- 2013 – Dr. Walker becomes AANEM President
- 2014 – Publication on CTS in Poultry Workers
- 2018 – Work on Chemotherapy-induced neuropathy
- 2020 – ISPNI names award after Dr. Walker

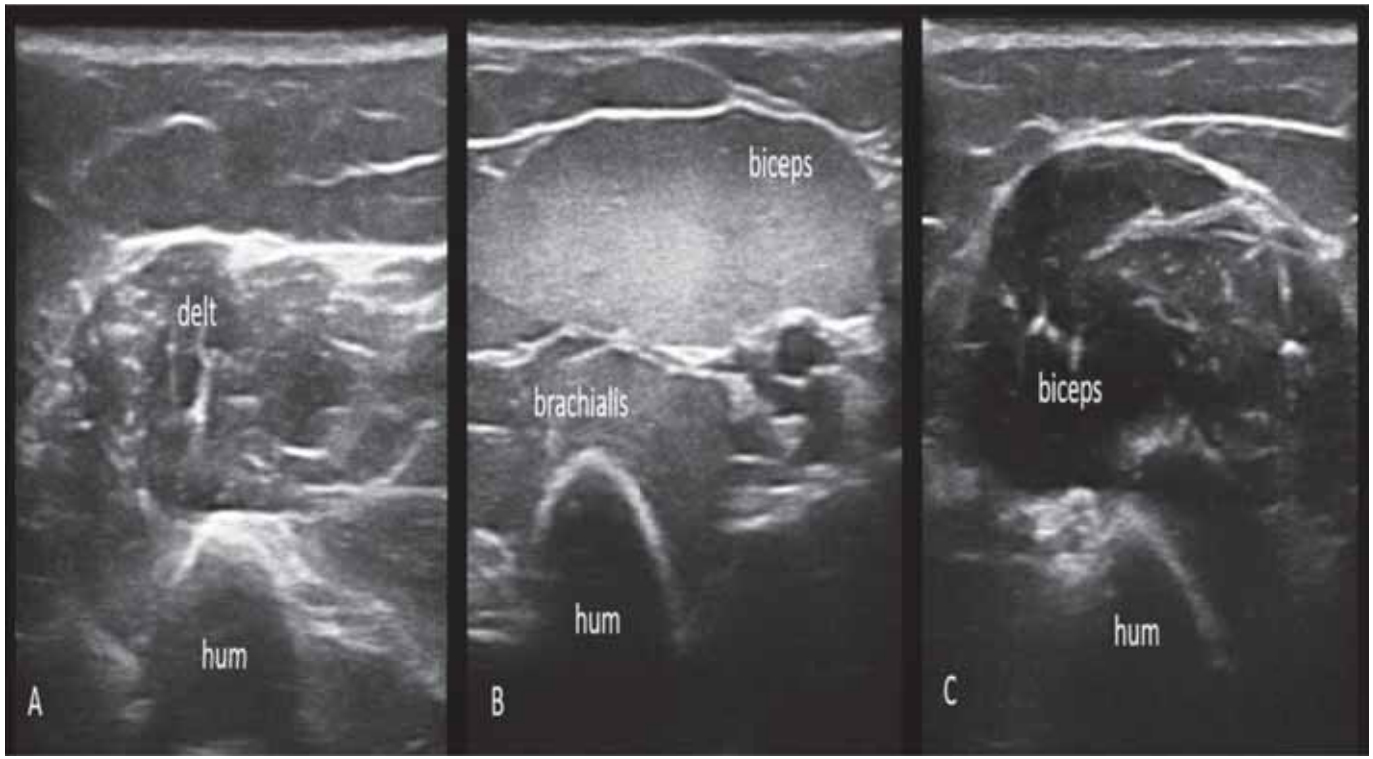
The Real Power of NMUS

- Collaboration – Neuro Onc, Family Med, Ortho, Plastics, Epidemiology, Biostats, ENT, students, residents, fellows
- Policy – OSHA slowed down poultry processing rates
- Patients – We use NMUS multiple times per day in the EMG lab

Patient

- 12 year old boy presents with elevated CK
- Exam shows very mild proximal weakness
- EMG of IP and quad – normal
- NMUS

Patient



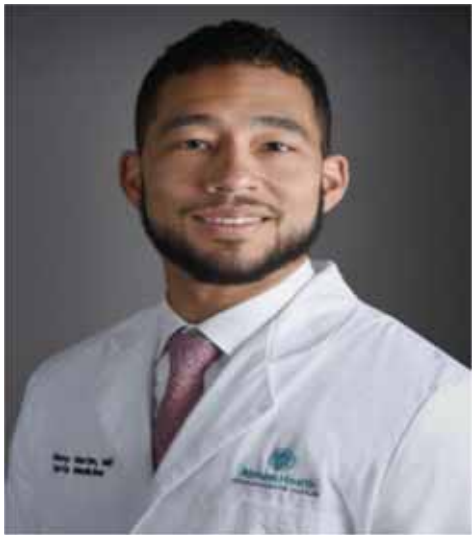
Patient

- Biceps biopsy → glycogen
- Genetic testing → Pompe disease
- Now on Lumizyme to maintain strength and prevent cardiomyopathy
- Diagnoses are improved daily because of NMUS

Thank You!

POCUS in Family and Sports Medicine

Anthony Martin, MD, CAQSM
Brent Messick MD, CAQSM



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Point of Care US In Family Medicine

TABLE 3

Musculoskeletal Ultrasonography of the Shoulder Compared with MRI

	Musculoskeletal ultrasonography		MRI	
Condition	**Sensitivity**	**Specificity**	**Sensitivity**	**Specificity**
Calcifying tendinitis	100%	85% to 98%	98%	96%
Full thickness rotator cuff tear	92%*	93%	94%*	93%
Partial thickness rotator cuff tear	52%	93%	74%	93%
Subacromial bursitis	79% to 81%	94% to 98%	Not reported, higher than ultrasonography	

MRI = magnetic resonance imaging.

*—A Cochrane review found these sensitivities were equivalent.

Information from references 30-33.

Why

- Decreased time to diagnosis and treatment
  - POCUS study in rapid response teams
    - POCUS group 15 min
    - Control group 34 min ($p<0.001$)[1]
- Similar accuracy in diagnosis to MRI in specific settings, ie MSK[2]
    - Sensitivity 92% in MSK US diagnosis of full thickness cuff tear
    - Sensitivity 94 % with MRI
  - Possible reduction in cost (less X-Ray/CT/MRI)?
  - Limits radiation exposure

Arnold, MJ; Jonas, CE; Carter, RE. Point of care ultrasonography. American Family Physician. 2020

Point of Care US In Family Medicine

Sought after by most medical students matriculating to residency

- Developing a curriculum
  - Barriers[3]
    - Lack of trained faculty
    - Limited access to equipment
    - Discomfort with interpreting images without radiologist review
  - Solutions
    - Select a champion
    - Dedicated coursework/conferences
    - Teach the teachers

Table 4: Program Directors' Ranking Perceived Barriers to Point-of-Care Ultrasound in Their Residencies

2014		Change in Rank	2019	
Barriers that have deterred or made it difficult for the establishment of point-of-care ultrasound training in your residency program include (rank sum):	Rank		Rank	Barriers that have deterred or made it difficult for the establishment of point-of-care ultrasound training in your residency program include (rank sum):
My faculty lacks appropriate training in performing point-of-care ultrasound. (467)	1	→	1	My faculty lacks appropriate training in performing point-of-care ultrasound. (560)
Our program does not have adequate access to ultrasound equipment. (212)	2	→	2	Our program does not have adequate access to ultrasound equipment. (219)
Physicians feel uncomfortable interpreting ultrasound images without having a radiologist available to over-read them. (113)	3	→	3	Physicians feel uncomfortable interpreting ultrasound images without having a radiologist available to over-read them. (157)
Clinic or hospital system policies do not permit family physicians to use ultrasound in a meaningful way. (96)	4	↘	4	The time physicians spend performing ultrasound examinations may not be reimbursed by insurance. (99)
The time physicians spend performing ultrasound examinations may not be reimbursed by insurance. (90)	5	↗	5	Ultrasound examinations are too time consuming to be done in a busy clinic. (98)
There is no time in our current curriculum to add ultrasound training. (86)	6	↘	6	Clinic or hospital system policies do not permit Family Physicians to use ultrasound in a meaningful way. (85)
Our program does not see a need for family doctors trained in point-of-care ultrasound. (44)	7	↗	7	There is no time in our current curriculum to add ultrasound training. (82)
Ultrasound examinations are too time-consuming to be done in a busy clinic. (36)	8	↘	8	There are insufficient data to prove that point-of-care-ultrasound improves patient outcomes in the ambulatory setting. (39)
There are insufficient data to prove that point-of-care-ultrasound improves patient outcomes in the ambulatory setting. (34)	9	↗	9	Our program does not see a need for family doctors trained in point-of-care ultrasound. (23)
Students and residents are uninterested in learning point of care ultrasound. (15)	10	→	10	Patients prefer ultrasounds to be done by radiology departments rather than by their primary physician. (13)
Patients prefer ultrasounds to be done by radiology departments rather than by their primary physician. (0)	11	↘	11	Students and residents are uninterested in learning point of care ultrasound. (10)
Other				Other (32)

Hall, JW et al. Point of Care Ultrasound in Family Medicine Residencies 5-year Update. Fam Med. 2020

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Proposed Curriculum

Multiple Settings

- Hands on didactics teaching every other month with several faculty
- Inpatient setting and outpatient residency clinics at 3 different sites
- Faculty and resident “champion”
- SonoSim
  - Scalable, Trackable, Gradable
  - Allows resident to visualize normal and abnormal pathology
  - On their own time!

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Cabarrus PCSM Fellowship

SMART Statements

- After completing the Musculoskeletal Ultrasound (MSK US) module during fellowship year which will include a MSK ultrasound instructional course, AMSSM MSK modules, and reading an introduction to MSK PowerPoint, the fellow will be able to show that they can describe technical aspects of MSK US, machine controls, probe positioning and ultrasound physics by scoring greater than 80% on a written exam.

- After passing the initial exam and in the fourth quartile of fellowship, the fellow will demonstrate competence in ultrasound scanning of the musculoskeletal system. The fellow will be evaluated by a standard rubric which will be scored based on image quality, exam technique and accuracy of needle placement.

MSK US Rubric

	Unacceptable (Does not position patient properly, never changes machine settings, poor quality images)	Needs Improvement (Sometimes positions patient properly, sometimes changes machine settings, few images of acceptable quality)	Pass (Often positions patient properly, uses more than machine setting to enhance the image, good quality images)	Honors (Consistently positions patient properly, comfortably uses all (gain, focal zone, depth, frequency) setting adjustments to optimize the image, image quality by changing machine settings, high quality images)
Patient Positioning				
Optimizing Image Quality				
Quality of Saved and Properly Identified Images				

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One Hand and One Eyesight Real-Time Ultrasound Guidance

The Use of Computer Assist Design and 3D Printing for Development of New Tools to Improve Vascular Access

Department of Anesthesiology

Luiz Maracaja MD

- Cardiothoracic Anesthesiologist
- Clinical Associate Professor
- Computer Assist Design

Conflict of Interest related to this presentation

Founder of Pneumocyte
Inventor of ultrasound accessories.

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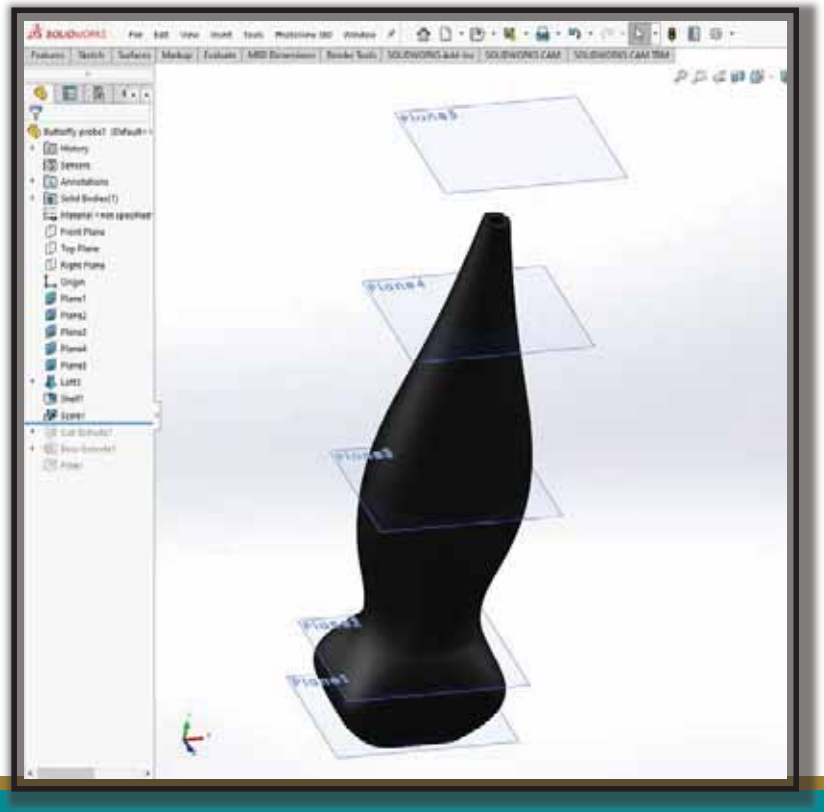
Real Time Ultrasound Guidance

- Definition
  - Continuous imaging of anatomic target and the needle during its trajectory through the tissues.
- Advantages of the Portable systems
- Challenges for adoption in Clinical practice
  - Display placement
  - Redundant cable
  - Sterility



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Proposal and essential design features

One

Mount the smartphone (display) directly on the top of the ultrasound transducer.

Two

Lightweight, weight distribution, stability, cable containment.

Three

Fit into a sterile cover and feasibility to manipulate the display through the cover.

Four

Positioning system will not interfere with scanning, improve ergonomics and hand-eye coordination.

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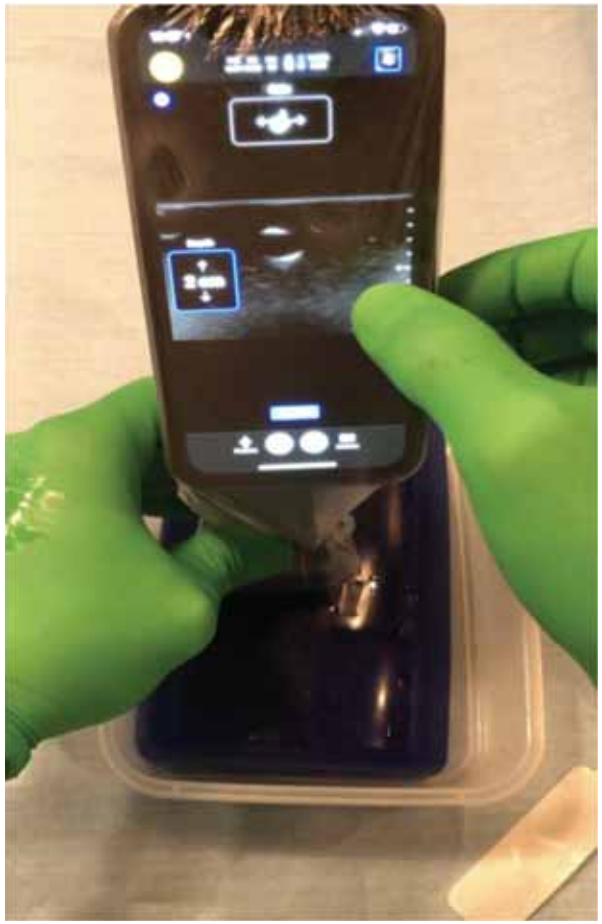
Improvement

- procedural site, ultrasound image, needle, syringe, and probe all in one view.
- Eliminate changes in the field of gaze between procedural site and ultrasound display (short interruptions related to inadverted movement of proceduralist).



Conclusion

The procedural field is an exciting realm for portable ultrasound systems.

The use of computer-assisted design and 3D printing allows tool customization for processes newly adopted in clinical practices.

Putting procedural site and ultrasound image in a single frame gives more stability and precision for procedural guidance.

Journal of Cardiothoracic and Vascular Anesthesia

Emerging Technology Review

One Hand and One Eyesight Real-Time Ultrasound Guidance: The Use of CAD Design and 3D Printing for Development of New Tools to Improve Vascular Access

Luiz Maracaja, MD, Daina Blitz, MD, Danielle L.V. Maracaja, MD, Caroline Walker, MD, Leon Freudzon, MD

lmaracaj@wakehealth.edu

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Evaluation of Success in Spinal Block Placement between using Palpation of Landmarks versus Pocket-Size Handheld Ultrasound Method in Cesarean Delivery

J. Pan MD, J.K Chadha MBBS, V H Ross, MD, L. Harris BSN, P. Pan MD, J. Booth MD

Department of Anesthesiology at Wake Forest School of Medicine

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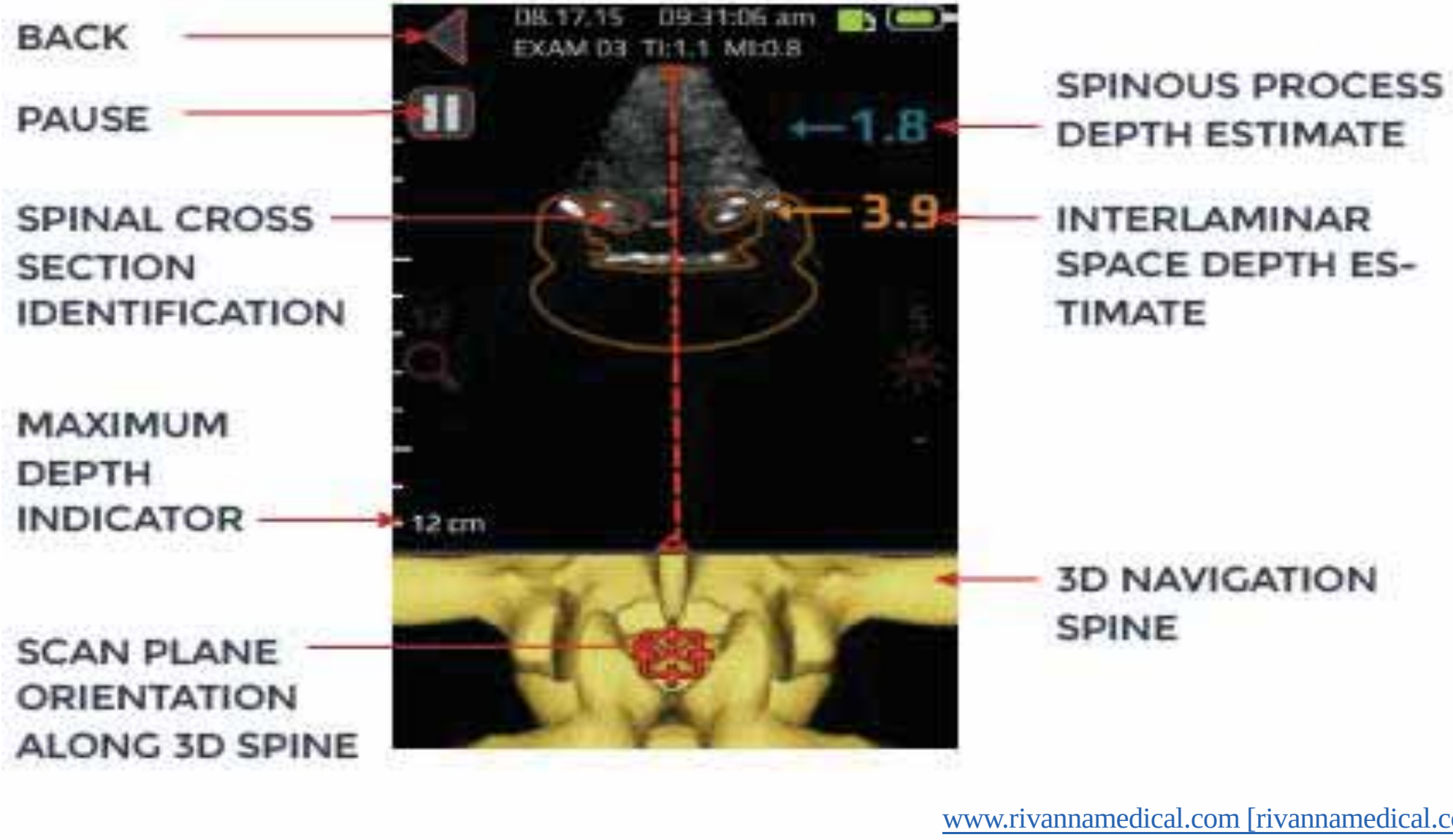
Learning Objectives

- ~~Review Using Palpation of Landmarks for Lumbar Neuraxial Block Placement~~
- ~~Review Technique for Ultrasound(US) Guided Lumbar Neuraxial Block using Traditional Ultrasound and Pocket Size US with 2D and 3D Navigator~~
- Does such US device improve spinal block placement in obese parturient undergoing cesarean delivery?
  - Procedural Time
  - Patient Satisfaction

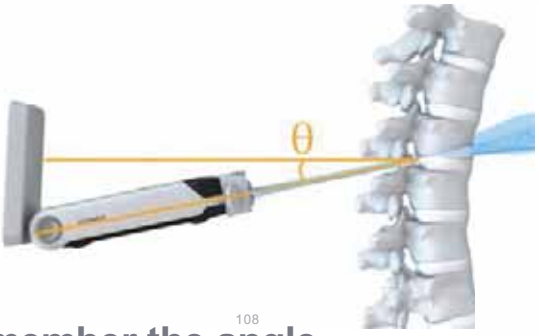
Dedicated Pocket Size Ultrasound devices (Accuro) for Neuraxial Blocks

- Software designed to image around bony structures and Preset for imaging Neuraxial block
- Utilizes a piston US transducer instead of linear or phase array → improves image quality around bony structures
- Uses bone specific beam-forming image processing
- Real time Pattern Recognition algorithm with a 2-D and 3-D Overlay Navigator for midline, spinous process, vertebral body, and intervertebral/ interlaminar spaces



www.rivannamedical.com [rivannamedical.com]

Accuro Ultrasound (By Rivanna Medical)



Remember the angle of the US probe – same angle of needle insertion

Accuro Locator Needle Guide - Skin Marker to mark site of needle insertion

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Does Accuro (3-D Assisted Pocket-Size Ultrasound) clinically improve Spinal block for obese parturient ?

- Limited clinical data and Lack clinical RCTs on US device with 3D Navigator for SAB placement in obese parturient.

- We **hypothesize** Accuro Ultrasound device may:
  1. **Reduce time**
  2. **Reduce Attempts**

  for successful placement of SAB versus traditional Palpation of Landmark method in obese parturient undergoing spinal anesthesia for cesarean delivery.

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Results

62 Subjects enrolled
- **BMI >30**
- Undergoing SAB for Cesarean Delivery

Randomized into one of two groups
2 Excluded for Protocol Violation

1 subject excluded for CA2+ performed the SAB

1 subject excluded for mistakenly assigned to the US group

30 subjects in Palpation guided group

110

30 subjects in US guided group

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Demographics

	Palpation Group (n = 30)	Ultrasound Group (n = 30)	P - Value
Age (years)	32.4 ± 5.8	29.8 ± 4.8	0.06
BMI (kg/m2)	38.9 ± 6.0	36.3 ± 5.4	0.08
EGA (days)	267.4 ± 11.1	269.7 ± 13.0	0.45
Gravida	3 [2 – 4]	2 [2 – 3]	0.03*
Parity	1 [1 – 2]	1 [1- 1]	0.02*

Data expressed and compared as Mean±SD or Median [IQR] as appropriate

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RESULTS - Technique

		Palpation Group (n = 30)	Ultrasound Group (n = 30)	P - value
Passes (Number)	**Median [IQR]** (Mean±SD)	**2 [1 – 4]** (2.9 ± 2.3)	**1 [1 – 2]** (1.9 ± 2.1)	**0.005***
Re-Directions (Number)	**Median [IQR]** (Mean±SD)	**3 [1 – 6]** (4.1 ± 3.5)	**2 [0 – 3]** 2.2 ± 2.6	**0.02***
1 Pass 0 Re-Direction Success	**(%)**	13.3 %	30.0 %	0.21
1 Pass Any # Re-Directions Success	**(%)**	**33.3 %**	**60.0 %**	**0.005***

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RESULTS – Timing

	Palpation Group (n = 30)	Ultrasound Group (n = 30)	P - value
Spinal Needle Insertion to CSF Time–Median [IQR] (sec) (Mean±SD)	**122 [59 – 226]** (161.3 ± 148.7)	**50 [26 – 109]** (85.8 ± 120.0)	**0.003***
Palpating/US Scanning Time – Median [IQR] (sec) (Mean±SD)	**23 [18 – 40]** (27.6 ± 14.6)	**33 [27 – 47]** (43.1 ± 30.3)	**0.03***
Palpate/US+Needle Insertion to CSF- Median [IQR] (sec) (Mean±SD)	**158 [85 – 254]** (189.0 ± 152.3)	**82 [56 – 151]** (128.8 ± 132.6)	**0.04***

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RESULTS – Patient Experience

	Palpation Group (n = 30)	Ultrasound Group (n = 30)	P-Value
Verbal Pain Score of SAB Procedure (0 – 10, 0 being none, 10 being severe) **Mean ± SD**	4.2 ±. 2.6	3.5 ± 2.6	0.32
Verbal Satisfaction Score of SAB Procedure (0 – 10, 0 being not satisfy at all, 10 being very satisfy) **Mean ± SD**	8.3 ± 1.7	9.4 ± 0.8	0.01*

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Results

Improved Verbal Satisfaction score *

50% Reduction of procedure time*

Twice as likely for one pass with # any redirections*

* Indicates significantly different

Conclusion:

- Results showed this pocket size Ultrasound device with 2D and 3D navigator **shortens the time and decreases # of passes or redirections of spinal needle** to successfully obtaining CSF return during spinal block in obese parturient for CD as compared to using Palpation of Landmark

- While median US Scanning appeared to take **10 seconds longer** than Palpation of Landmark, **reduction in time to obtain CSF in US group was large enough** to compensate for the increase in scanning time and Patients seemed to have **higher overall satisfaction** in their spinal block procedural experience.

- Larger RCTs at other institutions should be performed to confirm our findings.

Global Health Ultrasound & Regional Anesthesia in the ED

Dr. Denise Fraga, MD, MPA

Guatemala Partnerships

- Pediatric Residency (Escuintla)
- Emergency Medicine Residency (Guatemala City)

Regional Anesthesia in the Emergency Department

- Fascia Iliaca Block
- **Erector Spinae Plane Block**
- Superior Trunk Block
- General Nerve Block Data Collection

COVID-19 Lung Ultrasound

- Multi-center study
- Data collection on lung ultrasound characteristics & patterns in COVID-19 patients
- Published 2021

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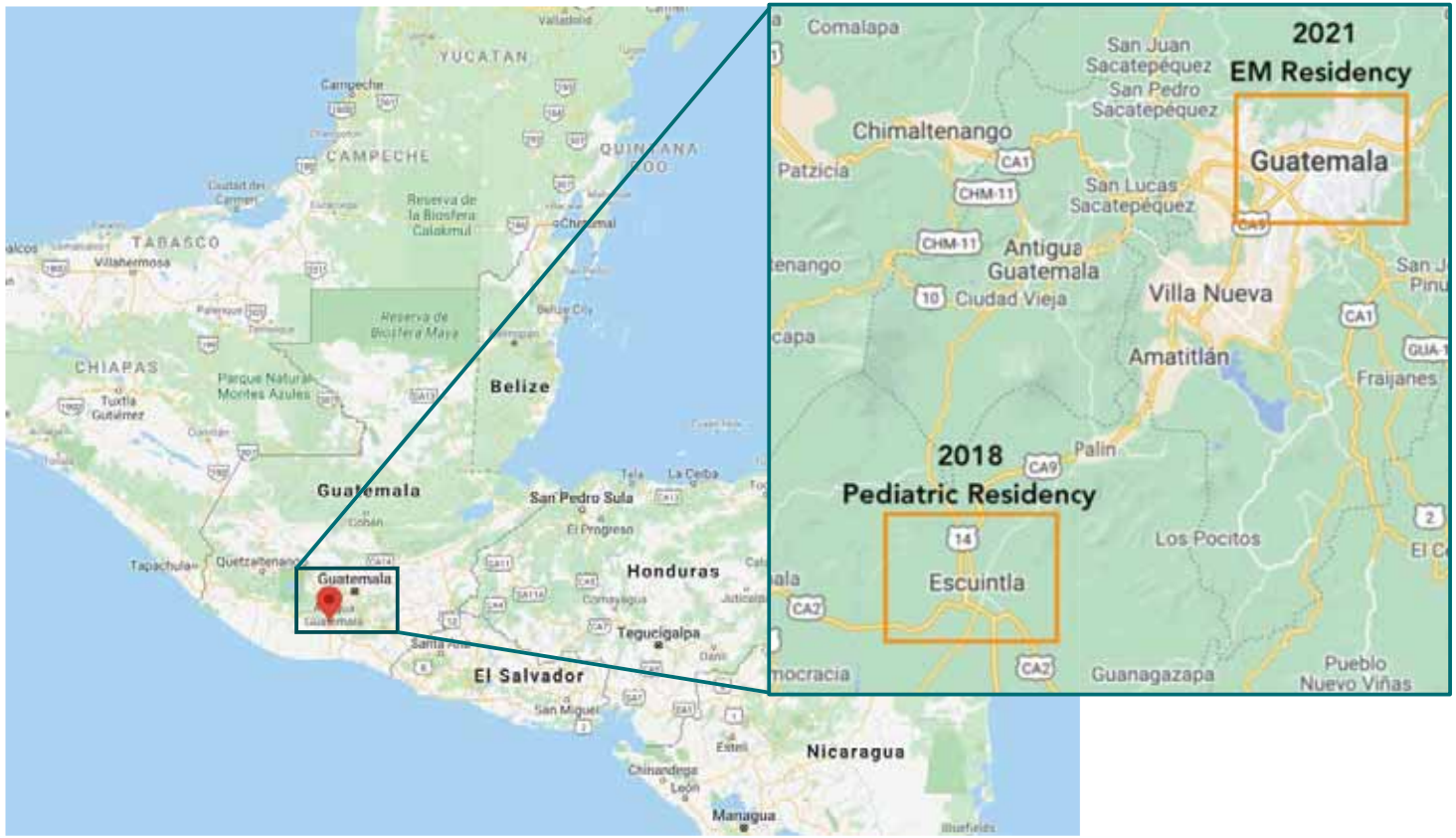
Global Health Ultrasound in Guatemala



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Global Health Ultrasound in Guatemala

Study: Development & Implementation of an Intensive Pediatric Point-of-Care Ultrasound (PoCUS) Curriculum in Guatemala

- Single center observational study
- Pre/Post written test & OSCE
- **Participants:** pediatric residents, fellows, attendings
- **Surveyed Participants:**
  - All but three learners reported no or minimal formal ultrasound training prior to the course
  - Barriers to ultrasound
- **Data Collection:**
  - Test Scores
  - Ultrasound use
  - Changes in clinical management w/ PoCUS

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Global Health Ultrasound in Guatemala

Applications and Pathology Taught During the Intensive Course

Ultrasound physics

Pediatric Abdomen
Basic anatomy
Appendicitis
Intussusception
Gall stones
Hydronephrosis
Bladder volume

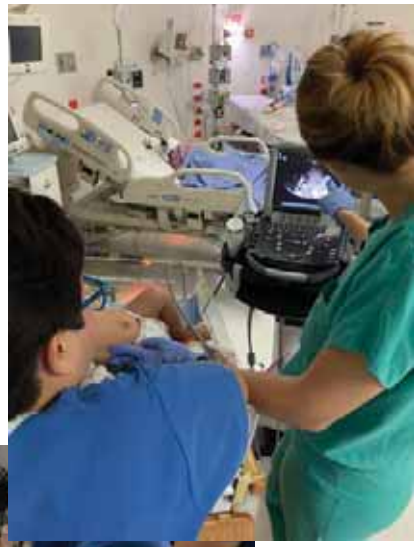
Lung
Lung sliding
Pleural fluid
Consolidation
B-lines

Soft Tissue
Abscess
Cobblestoning
Foreign body

Trauma FAST
Free fluid

Vascular Access
Peripheral venous access
Central venous access

Echocardiography
Ejection Fraction
Pericardial effusion
Basic cardiac anomalies
(ex. HOCM, Hypoplastic left heart, Tetralogy of Fallot)



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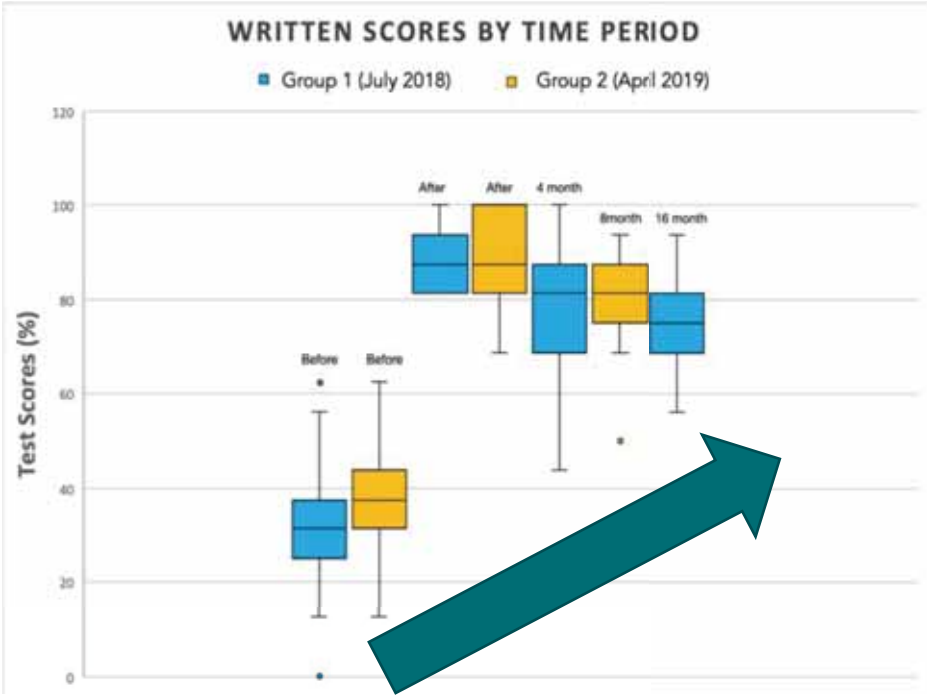
Global Health Ultrasound in Guatemala

Results

- Intensive 4-day PoCUS training course paired with follow up training in a resource limited setting led to improved ultrasound knowledge & long term knowledge retention
- Over 22-month period since the project was initiated, 614 ultrasound studies documented
- 36.5% had change in clinical management when ultrasound was used w/ PTX most common diagnosis
- Pending Publication



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Regional Anesthesia in the ED

Study: Efficacy of Performing Erector Spinae Plane (ESPB) & Serratus Anterior Plane Blocks (SAPB) for Rib Fractures in the Emergency Department

- Prospective Observational Study
- **Patients**: >=18 yo with 2+ rib fractures presenting to the ED
- **Aim 1:** Are EM providers able to safely & effectively perform ESPB or SAPB in the ED?
- **Aim 2:** Change in pain scores, IS, & cough score. Opioid reduction and complications.

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Regional Anesthesia in the ED

Phase 1 Results

- **88%** providers surveyed had either not performed or performed infrequently
- Pre-test (March 2020) > Post-test (March 2020) > Follow up test (June) showed statistically significant score **increase**

Phase 2 Results

- **31 blocks** performed in the ED for rib fx of which 97% ESPB
- Success rate = 90.3%
- Complication rate = 0%

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Covid-19 Lung Ultrasound

Study Details

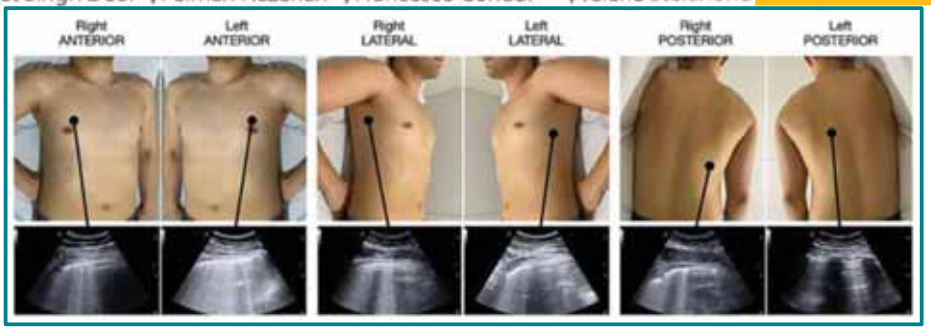
- International multicenter observational study
- **Aim 1:** Describe dx accuracy of the combination of **LUS probability patterns** (HighLUS, IntLUS, AltLUS, LowLUS) & **clinical phenotypes** (mild, severe, mixed) in predicting COVID-19
- **Aim 2:** Test an online training to implement a standardized LUS approach for COVID-19 in centers w/ different level of LUS expertise
- **Hypothesis:** std LUS exam is **feasible & reproducible**, and can be useful for **early prediction** of RT-PCR results in pts suspected of COVID-19

Intensive Care Med (2021) 47:444–454
https://doi.org/10.1007/s00134-021-06373-7

ORIGINAL

Lung ultrasound for the early diagnosis of COVID-19 pneumonia: an international multicenter study

Giovanni Volpicelli[1*], Luna Gargani[2*], Stefano Perlini[3], Stefano Spinelli[4], Greta Barbieri[4], Antonella Lanotte[5], Gonzalo García Casasola[6], Ramon Nogué-Bou[7], Alessandro Lamorte[8], Eustachio Agricola[9,10], Tomas Villén[11], Paramjeet Singh Deol[12], Peiman Nazerian[13], Francesco Corradi[14,15], Valerio Stefanone[16], Denise Nicole Fraga[17],



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Covid-19 Lung Ultrasound

Results

1. **HighLUS & IntLUS sen of 90.2%** (95% CI 88.23–91.97%) in identifying pts with + RT-PCR
   - **mixed** (**sen**: 94.7%) & **severe** (**sen**: 97%)

2. **HighLUS spec of 88.8%** (CI 85.55–91.65%)
   - higher **spec** in **mild ph** (94.4%; CI 90 – 97%)

3. Multivariate analysis: **HighLUS was strong indep predictor of RT-PCR +** (odds ratio 4.2, confidence interval 2.6–6.7, $p < 0.0001$)

Conclusions

- In patients suspected for COVID-19, lung ultrasound **patterns of probability** integrated with **patients' characteristics** allow to rule in or rule out COVID-19 pneumonia at bedside with high accuracy.

- This approach could support and expedite patients' management during a pandemic surge.

Ultrasound In Pediatric Emergency Care

Lindsey Chaudoin, MD

Department Learners

- EM and Pediatric residents
- US and PEM fellows

Ongoing Research

- Intussusception
- Testicular Torsion

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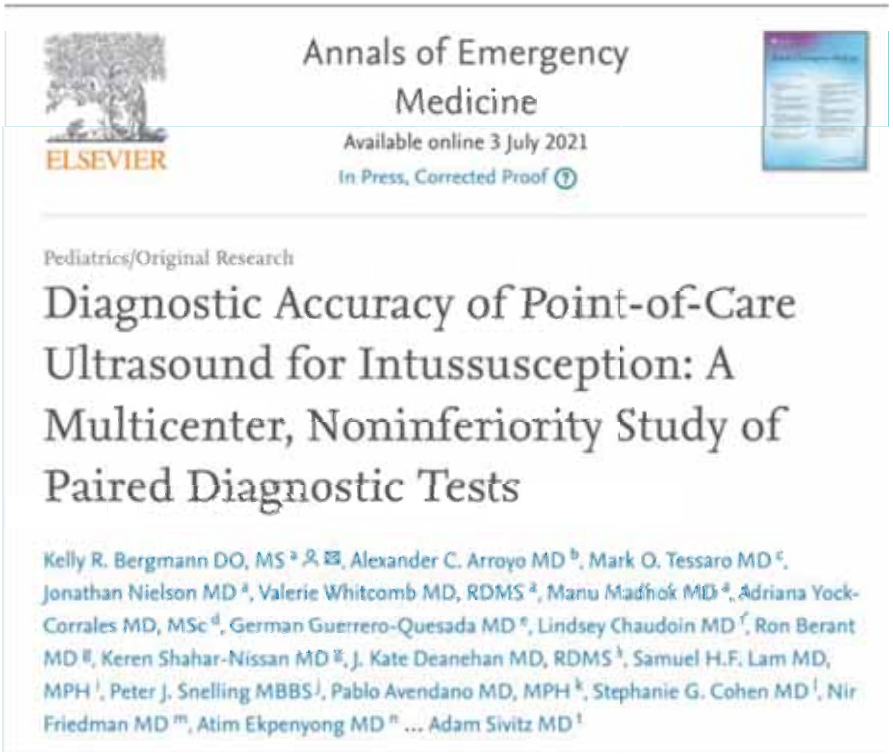
Intussusception

Study #1

- Prospective multicenter enrollment of patients suspected of intussusception
- Assessing accuracy of POCUS and RadUS
- 256 patients, 22% with intussusception
- **Accuracy: 97.7% POCUS** (CI 95% 94.9-99%)
  99.3% RadUS (CI 95% 96.8-99.9%)
- Pending Publication



ELSEVIER

Annals of Emergency Medicine

Available online 3 July 2021

In Press, Corrected Proof

Pediatrics/Original Research

Diagnostic Accuracy of Point-of-Care Ultrasound for Intussusception: A Multicenter, Noninferiority Study of Paired Diagnostic Tests

Kelly R. Bergmann DO, MS [a], Alexander C. Arroyo MD [b], Mark O. Tessaro MD [c], Jonathan Nielson MD [a], Valerie Whitcomb MD, RDMS [a], Manu Madhok MD [a], Adriana Yock-Corrales MD, MSc [d], German Guerrero-Quesada MD [e], Lindsey Chaudoin MD [f], Ron Berant MD [g], Keren Shahar-Nissan MD [g], J. Kate Deanehan MD, RDMS [h], Samuel H.F. Lam MD, MPH [i], Peter J. Snelling MBBS [j], Pablo Avendano MD, MPH [k], Stephanie G. Cohen MD [l], Nir Friedman MD [m], Atim Ekpenyong MD [n] ... Adam Sivitz MD [t]

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Intussusception

Study #2

- Comparison of image interpretation of 100 intussusception studies
- Expert vs Novice POCUS users
- Hypothesis: Interrater reliability of POCUS for detection of intussusception is high among both expert and novice POCUS users

Testicular Torsion

Emergency Medicine-Urology Collaboration

- Prospective Observational Study
- Patients 11-18 yo presenting to the Children's ED being evaluated for testicular torsion

- Aim 1: Accuracy of POCUS when compared to RadUS/OR findings
- Aim 2:To evaluate resource utilization measures among patients

Ultrasound in Undergraduate Medical Education: Fourth Year POCUS Elective Experience

Dr. Joshua Zavitz, DO
Assistant Professor of Emergency Medicine
Director, POCUS MSIV Elective
Wake Forest School of Medicine

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Why the need for a POCUS course?

Medical student demand for POCUS

- Historically requesting special elective
- Residency feedback and interview season
- Additional skill set
- Applicable to multiple specialties
- Hands-on learning
- Dedicated time to focus on POCUS

Going from the ultrasound lab to patient care

- Pretest probability with POCUS impact on differential Diagnosis
- Clinical Decision making
- Safety of procedural US guidance
- Normal→ Pathology
- Learning excellent patient care!

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Curriculum

- Progression from general to subspecialist over ~4 weeks
- Scanning logs of normal and pathology
- Ultrasound research report
- Clinical case report
- Simulator experience
- Power-point presentation
- Ultrasound modules quizzes
- Direct Observation testing

Curriculum

Student weekly scanning schedule

Week One	Week Two	Week Three	Week Four
• Adult Emergency Medicine • Pediatric Emergency Medicine • Community Medicine	• Neuro Critical Care • Neurology • Pediatric Cardiology	• Medical Critical Care • **Internal Medicine • Sports Medicine • **Trauma	• Vascular • Adult Cardiology • Simulation • Direct Observation Testing

**schedule varies which week

Survey Data

Year	Number of Students	Quality of Education (Strongly Agree %)	Effective Teaching (Strongly agree %)	Respect and cooperation of faculty (Strongly agree %)
2017-18	10	89	56	86
2018-19	18	81	75	88
2019-20	20	59	53	71
2020-21	26	96	91	96
2021-22	22	86	100	100

**2021-22 average 123 scans per student

Interdepartmental Collaboration

Teamwork

- 10 Specialties
- Clinic, Inpatient, ED, and Community settings
- General and subspecialists
- Technicians, Attending physicians, Fellows and Resident educators
- Strength of our institution

Virtual COVID POCUS Curriculum

- 141 students
- Innovative 2 week curriculum
- Daily needs assessments
- Utilized cell phone simulated scanning techniques
- Live scanning sessions with family members
- Video conferencing software
- Significant improvement pre 58% to 88% post scores

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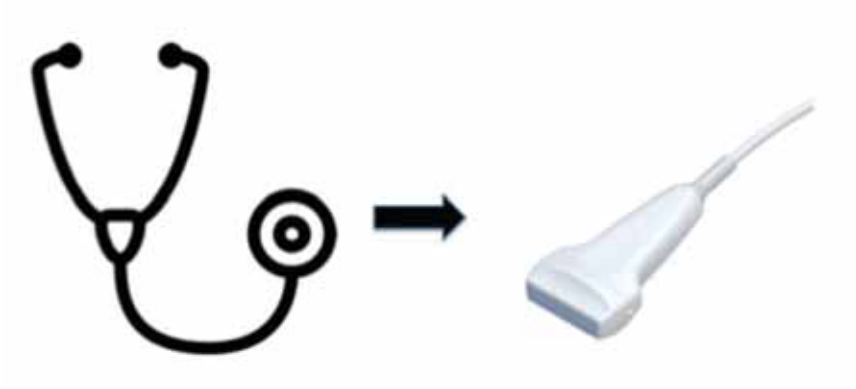
Scanning with a Purpose

Clinical focused video series

- Jennifer Mroz, Dr. Dillon Casey and Dr. Kristy Ford
- 15 live cases recorded
- Adult and pediatric
- Goal to share with students and residents
- Image acquisition → Interpretation → Implementation and clinical decision making

**In production currently



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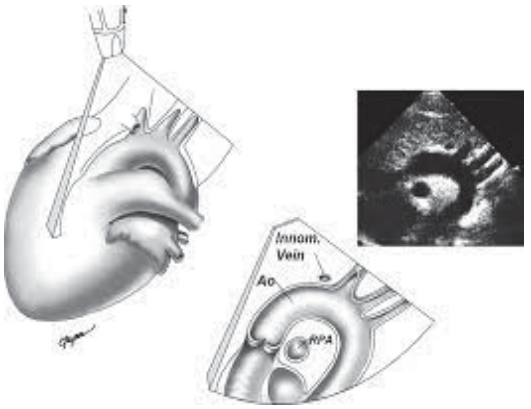
Pilot Research Project

Pediatric Cardiology

- Dr. Brandon Hays and technicians
- Started April 2021
- Student taught how to evaluate for coarctation
- Independently perform two on patients
- Direct observation testing
- Clinical utility: expedite diagnosis and life saving treatment!



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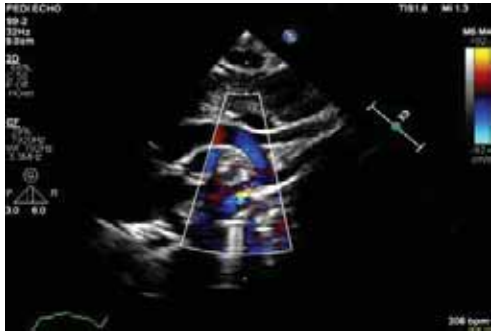
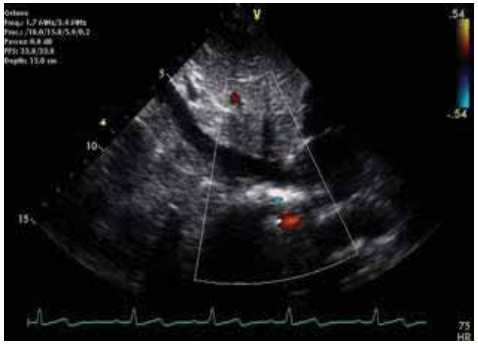
Coarctation Ultrasound views





POCUS Pediatric Coarctation Direct Observation Test

View	Points				Comments
Suprasternal Notch 2D	0	1	2	3	
Suprasternal Notch Doppler	0	1	2	3	
Subcostal Abdominal 2D	0	1	2	3	
Subcostal Abdominal Doppler	0	1	2	3	

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POCUS Elective Feedback

Challenges

Scheduling
Consistency
*Central coordinator improved

Successes

Clinical impact
Scanning numbers
Collaboration

Future

2 week mandatory course all MSIVs
Hand held US machines

“To continue to captivate we will need to insonate evaluate and collaborate to continue to innovate.”

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Ultrasound in Medical Student Education:

The Charlotte Experience for UNC SOM

Margaret Lewis, MD FACEP

Associate Professor of Emergency Medicine

Atrium Health Carolinas Medical Center

Margaret.Lewis@atriumhealth.org

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Evolution of an Ultrasound Curriculum

Charlotte Campus, UNC SOM

2013-2014

- CLT Longitudinal Integrated Curriculum (CLIC)
- 6 students chosen for novel approach
- **Longitudinal Ultrasound Curriculum Developed – 1st in UNC system**
- **4th Yr US elective**

2014-2015

- Increase CLIC students to 8
- **US curriculum continued for CLIC**
- **Self-Guided, Simulation-based US curriculum for Traditional students offered**

2015-2020

- All CLT campus students in CLIC for 6 months
- **Longitudinal US curriculum offered to all MS3**
- **Students participate in research and national US events**

2020-2021

- **COVID-19 virtual ultrasound elective offered with UNC**
- **Socially-distanced US education & game learning**
- **Learning through Social Media**

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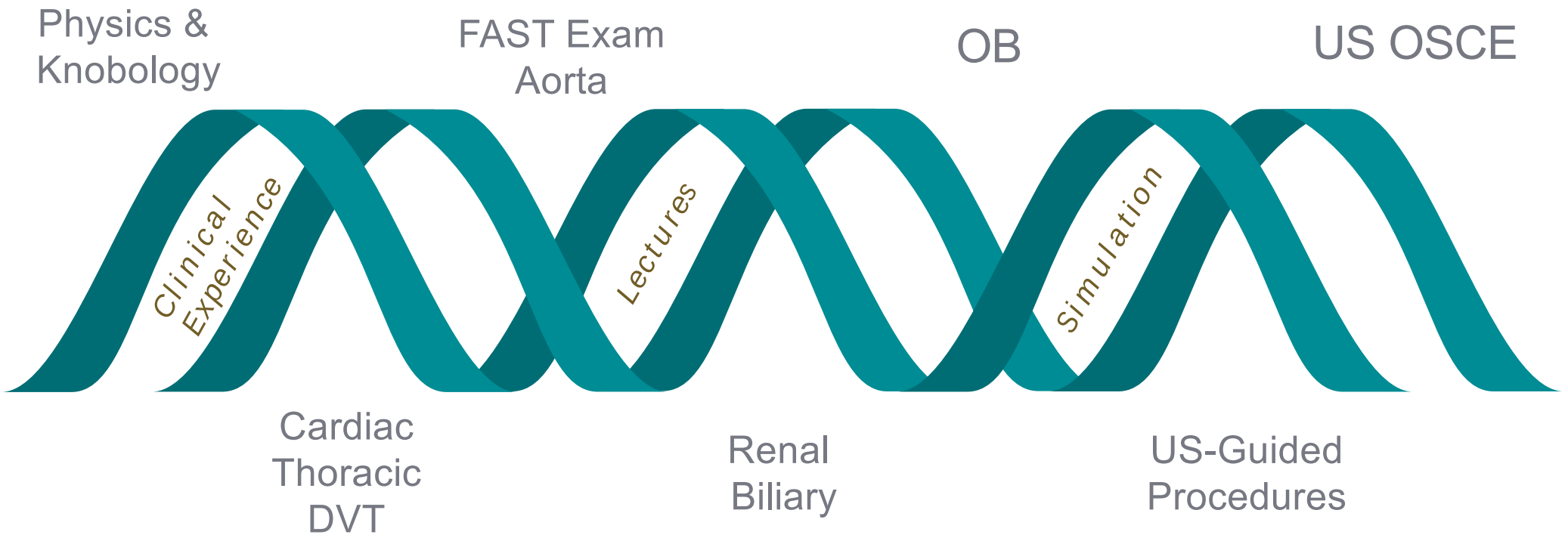
Ultrasound in UME Curriculum - Charlotte



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JRMC Journal of Regional Medical Campuses

Development and Evaluation of a Longitudinal Integrated Ultrasound Curriculum for Third Year Medical Students

Margaret R. Lewis, MD FACEP; Lisa Howley, PhD; Patricia White, MD; Celeste Colcord, MBA; Bryant K. Allen, MD.

Journal of Regional Medical Campuses, Vol. 1, Issue 2 (2018)

Journal of Emergency Medicine and Primary Care
Research Article: RD- EMP-10012

REDELVE INTERNATIONAL PUBLICATIONS

Evaluation of Self-Guided, Simulation-Based Ultrasound Education Versus Traditional Ultrasound Education for Third Year Medical Students

Jannach Lindsey[1], Anderson William E[2], Colcord Celeste[3], Lewis Margaret R[4*]

A National Point-of-Care Ultrasound Competition for Medical Students

Creagh Boulger, MD
Department of Emergency Medicine, The Ohio State University Wexner Medical Center, Columbus, Ohio USA

Rachel B. Liu, MD
Department of Emergency Medicine, Yale University School of Medicine, New Haven, Connecticut USA

Giuliano De Portu, MD
Department of Emergency Medicine, University of Florida College of Medicine, Gainesville, Florida USA

Nik Theyyunni, MD
Department of Emergency Medicine, University of Michigan Medical School, Ann Arbor, Michigan USA

Margaret Lewis, MD
Department of Emergency Medicine, Carolinas Medical Center, Charlotte, North Carolina USA

Resa E. Lewiss, MD
Department of Emergency Medicine, Thomas Jefferson University, Philadelphia, Pennsylvania USA

Zachary P. Soucy, DO
Department of Emergency, Dartmouth-Hitchcock Medical Center–Geisel School of Medicine, Hanover, New Hampshire USA

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Ultrasound in UME - The Charlotte Experience

- Fostering life-long learning through innovative approaches

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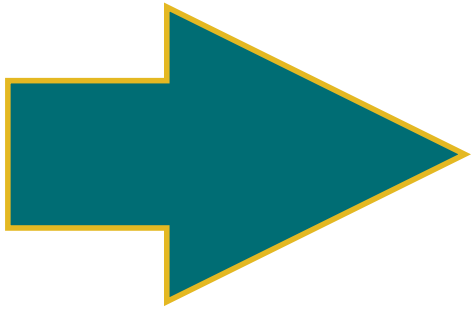
Future Directions

Collaboration to Improve Ultrasound Innovation, Education, and Research



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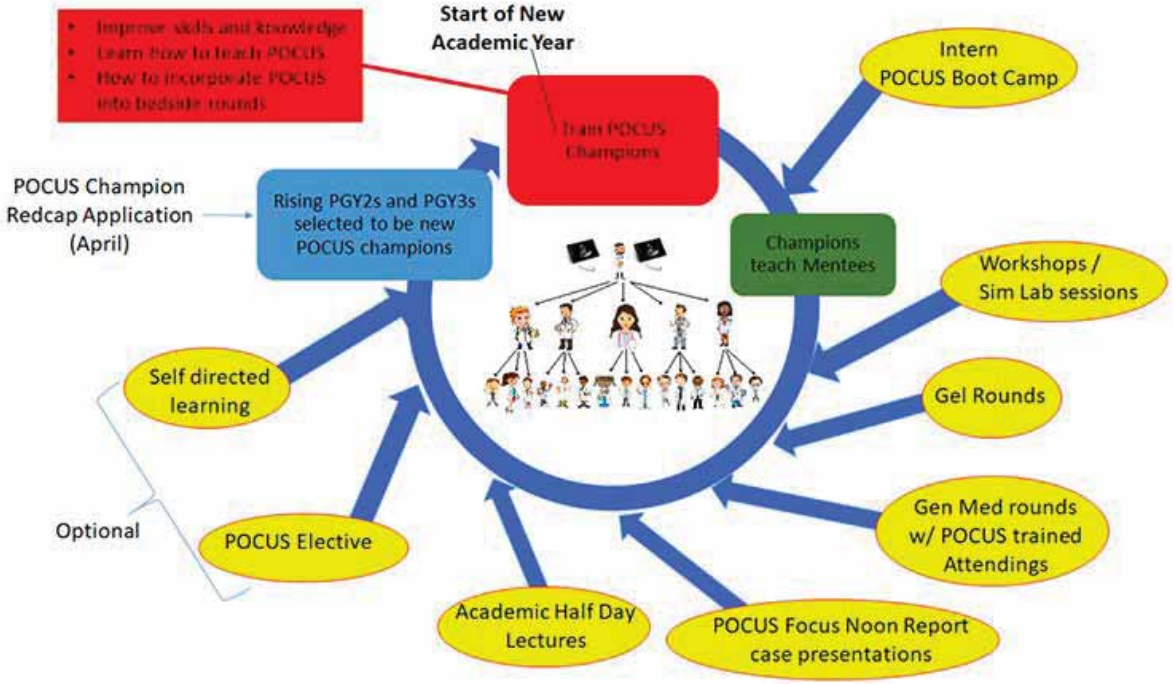
- Radiology
- Cardiology
- Obstetrics
- Emergency Medicine
- Internal Medicine
- Critical Care Medicine
- Anesthesiology
- Sports Medicine
- Neurology
- Surgery
- Pediatrics

POCUS Education for Internal Medicine Residents



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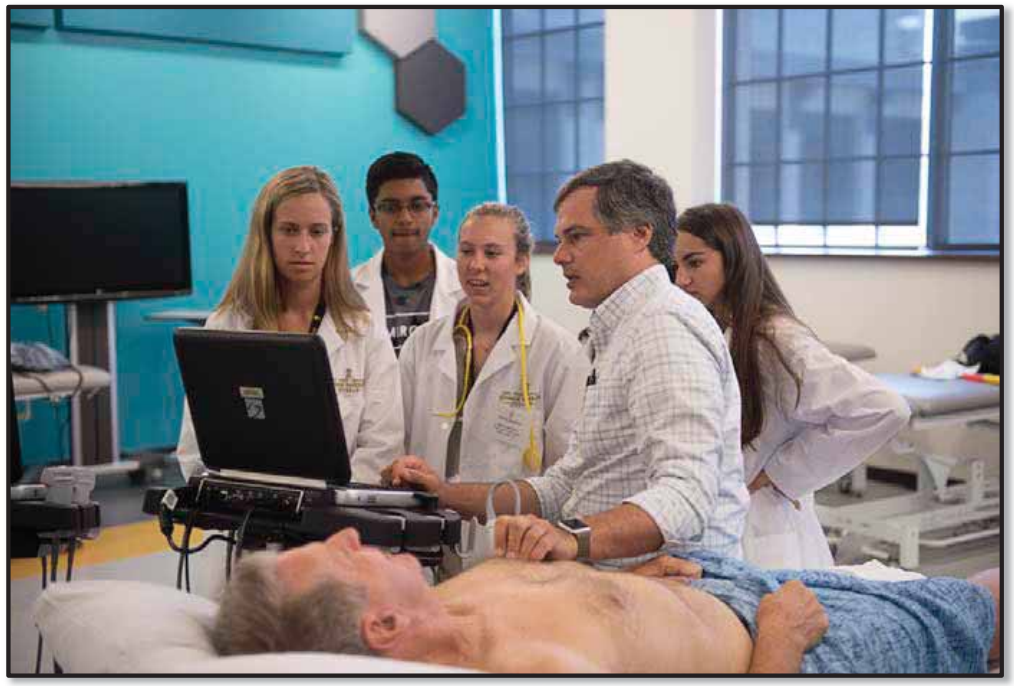

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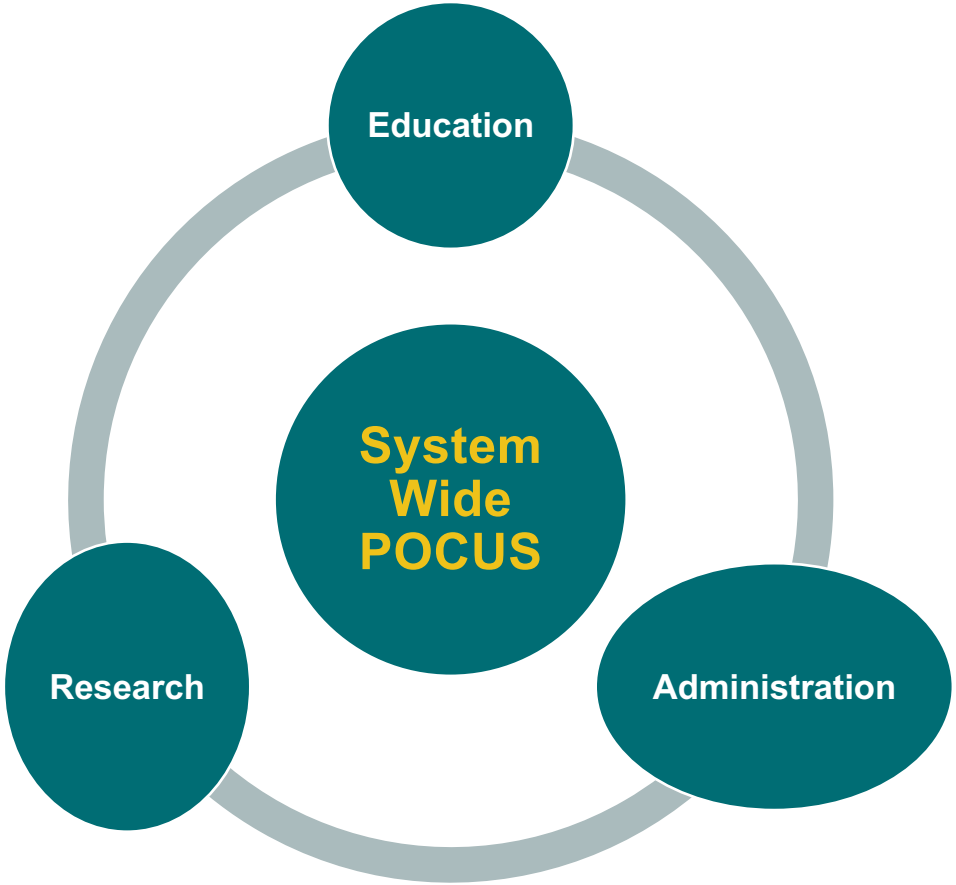
Education
System Wide POCUS
Research
Administration


Education
Hospital POCUS Committee
Research
Administration

Education

Centralized Bank of Ultrasound Resources

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Administrative
Standardize Workflows
Template Documents
Equipment Purchasing

Research

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CONNECT!

Ultrasound Research
Thursday, October 14; 4:00-5:30pm

- Find/meet new collaborators
- Spark new or interdisciplinary research ideas
- Connect informally with other researchers and learn about their work

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Hospital POCUS Committee

- System Wide Ultrasound Events
- Introductory Courses
- Administrative Coordination
- Foster Research Collaboration

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Atrium Research
More Patients
More Resources
More Ultrasound Experts

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Questions?

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Attention **All** Participants

To Receive CME Credit

Text Code: **CD31B**

To: **336-793-9317**

***MyAHEC account is required for credit**

For more instructions visit: **www.nwahec.org/textreg**

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