History of Ultrasound and Technological Advances

Jim Tsung, MD, MPH
New York, USA
3 Themes

• Asking a question
• Making an observation
• Solving a problem
1794: Lazzaro Spallanzani - Physiologist
First to Study Ultrasound Physics by Deducing Bats
used to ultrasound to navigate by echolocation
1826: Jean Daniel Colladon – Physicist

Uses Under-Water Church Bell (early ultrasound “transducer”) Under Water to calculate Speed of Sound through Water Prove Sound Travelled Faster through Water than Air.
1880: Pierre & Jacques Curie discover the Piezo-Electric Effect
1915: Paul Langevin – Physicist

After Titanic Sinking (1912) Invents Hydrophone (1\textsuperscript{st} Transducer) to detect Icebergs and Submarines during WW1
1942: Karl Dussik, Neurologist and Psychiatrist at the University of Vienna, generally regarded as the first physician to use ultrasound for medical diagnosis (of brain tumors)
1948: George Ludwig M.D.,- Internist first described the use of ultrasound to diagnose gallstones.

Ludwig, G.D. and Struthers, F.W. Considerations underlying the use of Ultrasound to detect Gallstones and Foreign Bodies in Tissue. Naval Medical Research Institute Reports, Project #004 001, Report No. 4, June 1949.
1958: Ian Donald Pioneers OB-GYN Ultrasound

**ARTICLES**

**THE LANCET**

**INVESTIGATION OF ABDOMINAL MASSES BY PULSED ULTRASOUND**

Ian Donald
Regius Professor of Midwifery in the University of Glasgow

J. MacVicar
M.B. Glasg., M.R.C.O.G.
Gynaecological Registrar, Western Infirmary, Glasgow

T. G. Brown
of Messrs. Kelvin Hughes Ltd.

Vibrations whose frequency exceeds 20,000 per second are beyond the range of hearing and therefore termed "ultrasonic". One of the properties of ultrasound is that it can be propagated as a beam. When such a beam crosses an interface between two substances of differing specific acoustic impedance (which is defined as the product of the density of the material and the velocity of the sound wave in it), five things happen:

1. Some of the energy is reflected at the interface, the amplitude of the reflected waves being proportional to the difference of the two acoustic impedances divided by their sum (Rayleigh's law). Therefore the greater the difference in specific acoustic impedance between two adjacent materials...
1950s: Douglass Howry & Joseph Holmes

pioneer 2D B-mode Ultrasound at the Univ. of Colorado
Social Networks & World Events

Lazzaro Spallanzani
Jean-Daniel Colladon
Pierre Curie
Alexander Belm
Reginald Fessenden
Kenji Tanaka
Toshio Wagai

Gabriel Lippman
WW1
Paul Langevin
Constantin Chilowsky
George Ludwig
Richard Bolt
John Wild
John Reid

Karl Dussik
Heinrich Netheler
W. Guttner
Theodore Hueter

Chih-Chang Hsu
Ian Donald

Wolf-Dieter Keidel

Ink Jet Printing

H. Thomas Ballantine
Carl Hertz
Inge Edler
Bertil Sundén

Douglas Howry
Joseph Holmes

Kenji Tanaka
Toshio Wagai

Sergei Sokolov
N. Selesneva
Diffusion of Ultrasound Through Medical Specialties

- Sports Medicine
- Internal Medicine
- Anesthesiology
- Critical Care
- Emergency Medicine
- Physiatry/PMR
- Peds Emerg Med
- General Pediatrics
- Cardiology
- OB-GYN

**Market share %**

- Innovators: 2.5%
- Early Adopters: 13.5%
- Early Majority: 34%
- Late Majority: 34%
- Laggards: 16%
1816-1819: Rene T. H. Laennec
Invents the Stethoscope and Publishes “De L’Auscultation Mediate”

1781-1826
“That it will ever come into general practice, I am extremely doubtful; because its beneficial application requires much time and gives a good bit of trouble both to the patient and the practitioner”

J. Forbes, 1823

Preface to the First English Edition of Laennec’s “Treatise”
1924: Lewis A. Connor M.D.
Founding President of the American Heart Association

• “Cornell’s Osler”
• Cornell Chair of Medicine 1916-1932
• Founding President of the New York Heart Association in 1915

1867 - 1950
Physical Exam Vs. CXR as Gold Standard: 
N=52; Sensitivity 47-69% /Specificity 58-75%

Wipf et al. Diagnosing Pneumonia by Physical Exam: Relevant or Relic? 
Arch Intern Med 1999

Point-of-Care Ultrasound as a stethoscope replacement?
1989: Daniel Lichtenstein pioneers point-of-care lung ultrasound in the ICU

“Ultrasound is the real stethoscope”
The WHO Estimates that Up to 75% of the world’s population has no access to any diagnostic imaging
An integrated ultrasound curriculum (iUSC) for medical students: 4-year experience

Critical US J 2010

Richard A. Hoppmann · Victor V. Rao · Mary Beth Poston · Duncan B. Howe · Patrick S. Hunt · Stanley D. Fowler · Lance E. Paulman · James R. Wells · Nancy A. Richeson · Paul V. Catalana · Lynn K. Thomas · L. Britt Wilson · Thomas Cook · Shaun Riffe · Francis H. Neuffer · James B. McCallum · Brian D. Keisler · Rachel S. Brown · Anthony R. Gregg · Kerry M. Sims · Caroline K. Powell · Matthew D. Garber · James E. Morrison · William B. Owens · Kevin A. Carnevale · William R. Jennings · Sarah Fletcher

A Pilot Study of Comprehensive Ultrasound Education at the Wayne State University School of Medicine

A Pioneer Year Review

J Ultrasound Med 2008

Sishir Rao, BA, Lodewijk van Holsbeeck, BA, Joseph L. Musial, PhD, Alton Parker, MD, J. Antonio Bouffard, MD, Patrick Bridge, PhD, Matt Jackson, PhD, Scott A. Dulchavsky, MD, PhD
2004: Tom: 'I Bought a Sonogram Machine' for Katie

“"A fool with a stethoscope will be a fool with an ultrasound machine”"  
-Dr. Justin Bowra
Solutions: Freely Available Internet Resources

www.sonoguide.com

www.SinaiEM.US

www.hqmeded.com

bringing technology to the bedside for improved patient care
Solutions: Telesonography

Cost-Effective Remote iPhone-Teathered Telementored Trauma Telesonography

J Trauma

Paul B. McBeth, MD, Trevor Hamilton, MD, and Andrew W. Kirkpatrick, MD, FRCSC, FACS
Virtual guidance: a new technique to empower point-of-care ultrasound in remote or extreme environments

R. Mercado-Young · D. S. Martin · T. Caine · K. O’Connell · K. Garcia · A. Sargsyan · S. Platts · S. A. Dulchavsky

Real-time video transmission of ultrasound images to an iPhone

Andrew S. Liteplo · Vicki E. Noble · Ben Attwood
Solutions: Simulation

• Technology:
  – Enable pattern recognition training by intensive video learning and simulation.
Public Access Defibrillator Model
• Ask a question
• Make an observation
• Solve a problem

Thank You!