

Shades of Gray: A History of the Development of Diagnostic Ultrasound in a Large Multispecialty Clinic

Laurie Troxclair, BS, RDMS, RVT, Dana Smetherman, MD, FACR, Edward I. Bluth, MD, FACR

Department of Radiology, Ochsner Clinic Foundation, New Orleans, LA

ABSTRACT

The Department of Radiology at the Ochsner Health System has been a central player in the development of ultrasound nationally and internationally for much of the history of this technology. In the following article, we review the progress of ultrasound in our institution.

THE EARLY YEARS CREATING THE ART OF ULTRASOUND 1975–1985

Since its inception, ultrasound has been an important diagnostic tool for displaying normal anatomy and pathology. The year 2010 marked the 35th anniversary of the introduction of ultrasound at the Ochsner Health System. In celebration of this important milestone, the Ultrasound Section of the Ochsner Health System has taken this opportunity to look back at where we have been and where we are headed.

In the early 1970s, the use of ultrasound (high frequency mechanical energy waves, like sound waves only with a higher frequency) as a means of creating images of the abdomen, small parts, and pelvis was introduced at radiology meetings and in the literature. Ultrasound represented a major advance in diagnostic imaging because it allowed the creation of cross-sectional images without the use of

ionizing radiation. In 1975, Dr Michael Sullivan sent two Ochsner residents, Drs Donald McBurney and Christopher Merritt, to a course to learn about this new technology and to bring it to Ochsner. Partnering with Dr Edward Bluth, who joined the Ochsner medical staff in 1977, Drs Sullivan and Merritt established Ochsner's Ultrasound Section and later the Program in Diagnostic Medical Sonography.

The instrumentation initially used was A-mode and B-mode static imaging, which produced only static or still images. Using this technique, it was possible to image the abdomen and pelvis, including evaluating the fetus during pregnancy (Figures 1 and 2). In 1979, real-time scanning was introduced, giving radiologists the ability to see live images depicting anatomy. Ochsner's Ultrasound Section was able to forge strong working relationships with commercial vendors, placing us at the forefront of the development of ultrasound instrumentation.¹

Within a few short years, the Ultrasound Section developed a nationally recognized laboratory of education, teaching, and research. The team of Drs Merritt, Bluth, and Sullivan created an atmosphere of learning and commitment to the art of ultrasound, expecting nothing less than perfection in imaging. During this time, the Ochsner ultrasound group reported many new advances in ultrasound, including the sonographic identification of pelvic lipomatosis and gastrointestinal abnormalities such as stomach cancer, lymphoma, colon cancer, inflammatory bowel disease, acute appendicitis, and metastatic peritoneal implants demonstrating the pseudokidney sign of bowel wall thickening (Figures 3a and b and 4a and b).²⁻⁶

The training of resident physicians and sonographers was essential to our initial success because organized schools and curricula for teaching ultrasound scanning did not exist at that time. Students were initially trained in an apprentice style of education. Subsequently, a program was established and sonography students received intense training in anatomy, pathology, and scanning technique during a 12-month program established in the early 1980s and originally directed by Cathy Smith, BS, RDMS.

Our present team leader, Laurie Troxclair, and Benita Barthel, a sonographer and former program director for the School of Diagnostic Medical Sonog-

Address correspondence to
Edward I. Bluth, MD, FACR
Chairman Emeritus
Department of Radiology
Ochsner Clinic Foundation
1514 Jefferson Highway
New Orleans, LA 70121
Tel: (504) 842-3470
Fax: (504) 842-6260
Email: ebluth@ochsner.org

Keywords: Doppler ultrasound, radiology, ultrasound

The authors have no financial or proprietary interest in the subject matter of this article.



Figure 1. Articulated arm bistable scanner in 1978.

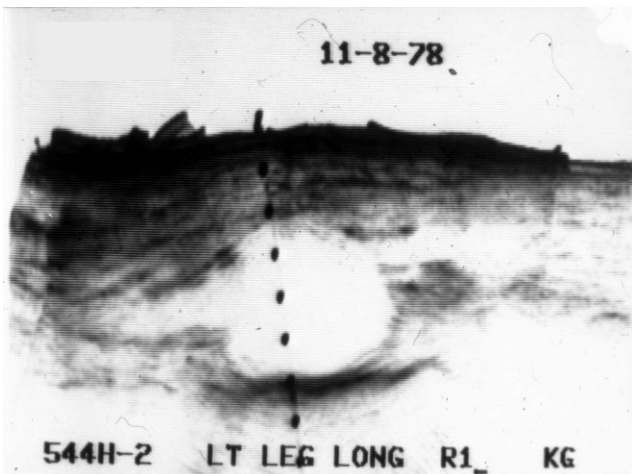


Figure 2. Bistable sagittal scan demonstrating a popliteal artery aneurysm. Note the white image background (different from our present black backgrounds), which was the initial accepted image format.

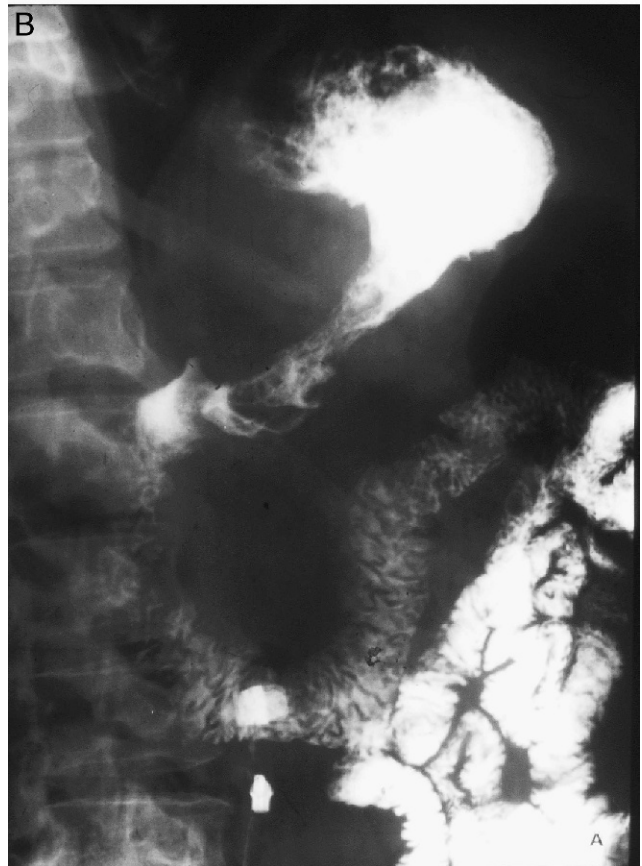
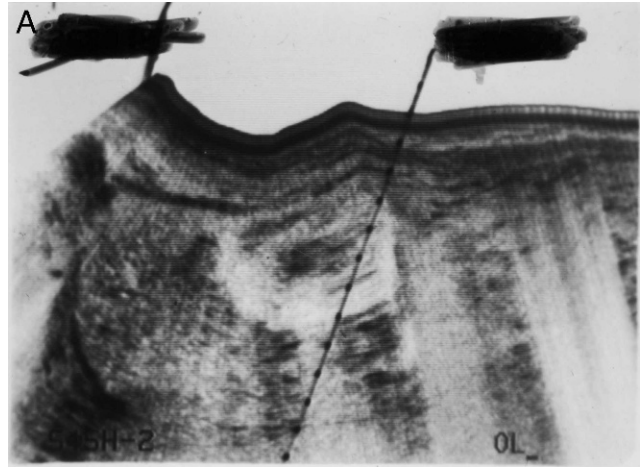


Figure 3. Articulated arm bistable sagittal scan (A) indicating a pseudokidney sign consistent with carcinoma of the stomach confirmed on upper gastrointestinal series (B) and surgically confirmed as adenocarcinoma.

raphy, began their careers as students in 1984. Graduates of the Ochsner School of Diagnostic Medical Sonography soon populated many departments throughout New Orleans and the country. Several of our attending radiologists trained as residents during these years, including Dr Dennis Kay, our present chairman, and Dr Charles Matthews,

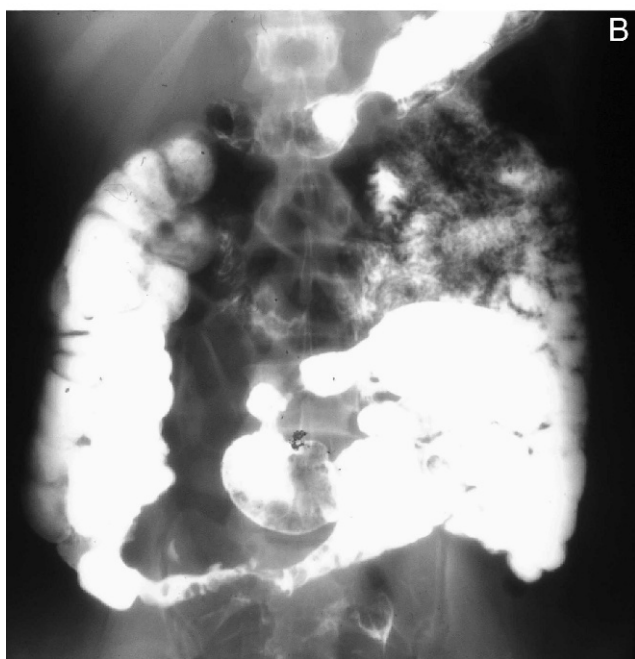
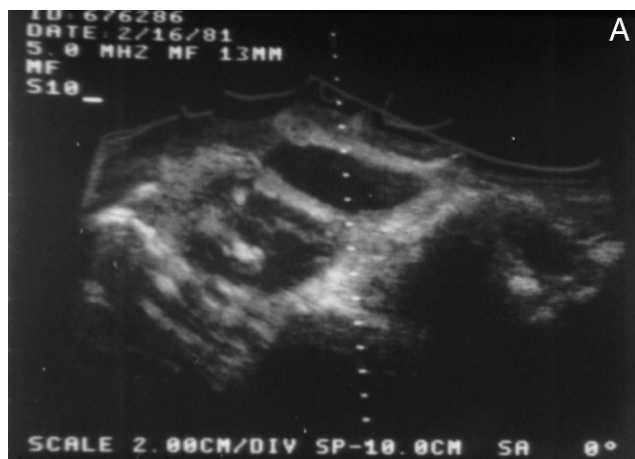


Figure 4. Transverse image (A) of the right lower quadrant demonstrating a pseudokidney sign corresponding to bowel wall thickening in the region of the terminal ileum. The follow-up small bowel series demonstrated findings consistent with regional enteritis (B).

who was the second Ochsner Fellow in Ultrasound (the first was Dr Michael Katz).

ADVENT OF COLOR THE DISCOVERY YEARS 1985–1995

Through the collaborative efforts of Drs Merritt, Bluth, and Sullivan, the Section remained on the cutting edge of technology and equipment. Static scanners were replaced with real-time imaging units. The next frontier in the development of ultrasound technology was the introduction of color Doppler that allowed the detection and visualization of movement

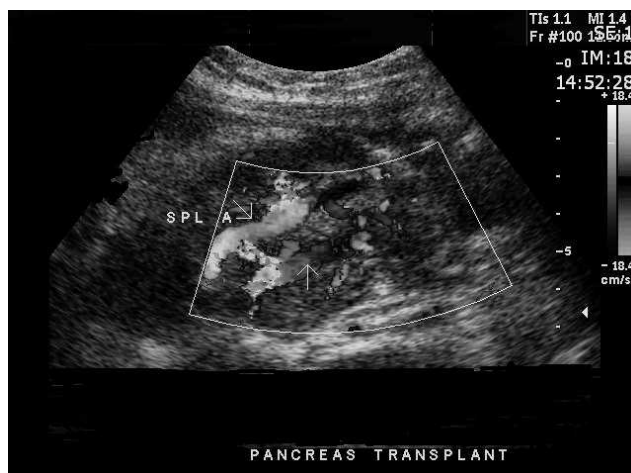


Figure 5. Pancreatic transplant visualized with color-flow Doppler imaging, demonstrating the patent splenic artery and vein.

(most importantly of flowing blood) toward and away from the ultrasound transducer. Ochsner's group was the first in the nation to have a color Doppler ultrasound unit. We undertook much of the initial work to understand how this new tool could contribute to imaging and patient care. Color Doppler provided patients with a safe, noninvasive method of demonstrating flow without catheter angiography or contrast dye (Figures 5 and 6). New diagnoses were now possible and were described in the literature by the Ochsner group.⁷⁻¹¹ Members of the Ochsner team edited the first textbooks on the usefulness of color flow Doppler imaging in 1992¹⁰ and 1996.¹²

In the early 1980s, the ultrasound group turned its focus to the use of ultrasound in evaluating the carotid arteries using both color Doppler and spectral Doppler, which allowed quantification of the velocity

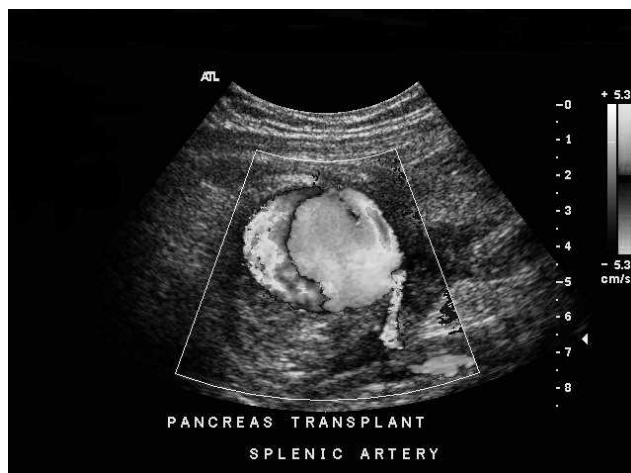


Figure 6. Color-flow Doppler image demonstrating a pseudoaneurysm of the splenic artery.

of flow. Dr Bluth published several major articles in the *American Journal of Roentgenology* and the *American Journal of Neuroradiology* identifying criteria for plaque characterization, intraplaque hemorrhage, and degree of carotid artery stenosis.¹³⁻¹⁵ In 1986, Dr Bluth was the lead author on the multicenter recommendation for standardized imaging and diagnostic criteria for carotid stenosis, which became a national standard.¹⁶

Soon ultrasound and Doppler caught the attention of not only radiologists but also physicians outside of radiology. Obstetrical and transrectal ultrasound were initially performed in the Radiology Department but were eventually performed by other specialties. Recognizing the importance of maintaining the quality of imaging, Drs Merritt and Bluth were instrumental in developing an accreditation process for vascular imaging. Our laboratory was one of the first departments in the country to be accredited by the Intersocietal Commission for the Accreditation of Vascular Laboratories (ICAVL) in 1991. At the same time, Ochsner's five sonographers—including current staff members Laurie Troxclair, Lauren Althans, and Michele Bienvenu—became registered vascular technologists (RVTs), joining a small group of dual-registered (registered diagnostic medical sonographer and RVT) sonographers nationwide. They also served as reviewers for ICAVL, evaluating other laboratories seeking accreditation for vascular imaging. Dr Merritt, Dr Bluth, and Laurie Troxclair have all served as board members of ICAVL.

TECHNOLOGICAL ERA THE PROGRESSIVE GROWTH YEARS 1995–2005

The next decade brought significant progress in computer equipment throughout the specialty of radiology. The Ultrasound Section was the first at Ochsner to become completely filmless, with the acquisition of a picture archiving and communication system (PACS) in 1996. This advancement freed the technologists from film development and greatly enhanced their productivity, enabling the Ultrasound Section to dramatically increase volumes.

Dr Bluth, who took the reins as Chairman of Radiology in 1998, wanted to move the Section into the future. With the success of the ultrasound PACS, he advocated for and ultimately introduced PACS to the entire Radiology Department and institution. A new generation of imagers was brought into our department during this time: Drs Dana Smetherman, Arthur Kenney, and Julie Sossaman. These younger, tech-savvy radiologists helped transition us into the new millennium. Ultrasound continued to evolve with the introduction of power Doppler (which had higher

sensitivity for detection of low-velocity flow), harmonic imaging, and postprocessing algorithms that improved the clarity of the images. Continuing to enhance the reputation of the Ochsner Radiology Department as a leader in ultrasound, Dr Bluth served as the editor of a major ultrasound textbook in 2000, *Ultrasound: A Practical Approach to Clinical Problems*,¹⁷ with a second edition published in 2007.¹⁸

Our experience and expertise in abdominal vascular imaging brought about challenging opportunities in the evaluation of transplanted organs. Many collaborative research projects evolved as we strove to meet the demands of the transplant physicians and their patients, including diagnostic criteria for identifying vascular abnormalities and rejection in liver and pancreas transplants.

During this time period, Ochsner Health System expanded its service areas in the Gulf South, producing an increased demand for capacity and access in our small group. It was obvious that we had outgrown our laboratory. In summer 2005, we moved into a larger space with state-of-the-art reading rooms and 12 private examination rooms.

RECOVERY AND GROWTH THE CHALLENGING YEARS 2005–PRESENT

They say things happen for a reason...When we moved into our new area in July 2005, little did we know that 1 month later, we would become a temporary hotel for many of our coworkers in the dark days during and after Hurricane Katrina. Despite the challenges and tragedies everyone faced during that time, our dedicated staff remained loyal to our region and to the department. Ochsner remained open throughout the storm and its aftermath, and our Team A technologists and radiologist (Kristin Casey, Laurie Troxclair, and Dr Dana Smetherman) were able to provide ultrasound examinations without interruption throughout that time. In the months following the storm, Drs Bluth and Sullivan continued to guide and support the entire group. We remained focused, committed to maintaining a high level of quality imaging despite the obstacles. This dedication served us well: The 5 years since Hurricane Katrina have been an era of unprecedented growth for Ochsner and the Radiology Department.

Our family has added many new radiologists since 2005—Drs Richard Tupler, Evan Liokis, Todd Layman, Francine Belleville, David Kirsch, Kori Safavi, and Erica Broussard. This group of talented physicians is playing a major role in helping us chart our course for the future in ultrasound imaging. Our technical staff has grown from the original 5 members to our current staff of 12 highly skilled sonographers, one of the

largest ultrasound groups in the southern United States. Our wonderful support and secretarial staff, led by Ida Barrow, completes our family and has contributed immeasurably to our success as a section. We have continued to contribute to the progress of ultrasound technology, having been chosen as a clinical site for an investigational study of an ultrasound intravenous contrast agent in 2010.

We are very proud of the progress we have made over the past 35 years and of where we are today. Since its inception, the Ochsner Ultrasound Section has trained more than 145 residents and 50 diagnostic medical sonography students, creating some of the most skilled imaging specialists in the country. Members of our staff have published more than 200 peer-reviewed articles and more than 10 textbooks and have been invited to speak at many meetings and forums both nationally and internationally. It has been an amazing, challenging, creative, sometimes difficult, but, most of all, rewarding experience. Thanks to all who made the journey so memorable.

REFERENCES

- Merritt CRB, Foreman M, Bluth EI, Sullivan MA. Abdominal ultrasound: clinical application of realtime. *Appl Radiol.* 1981;10(1):83-94.
- Bluth EI, Katz MM, Merritt CR, Jeanfreux W. Ultrasonic findings in pelvic lipomatosis. *South Med J.* 1979;72(9):1215-1216.
- Bluth EI, Merritt CR, Sullivan MA. Ultrasonic evaluation of the stomach, small bowel, and colon. *Radiology.* 1979;133(3 Pt 1): 677-680.
- Bluth E, Merritt C, Sullivan M. Ultrasound of small bowel abnormalities. *Gastroenterology.* 1981;80(5):11-14.
- McDaniel NT Jr, Bluth EI, Ray JE. Gastrocolic fistula in Crohn's disease. *Am J Gastroenterol.* 1982;77(8):588-589.
- Bluth EI. Ultrasound evaluation of small bowel abnormalities. *Am J Gastroenterol.* 1983;78(12):788-793.
- Bluth EI, Shyn PB, Sullivan MA, Merritt CR. Doppler color flow imaging of carotid artery dissection. *J Ultrasound Med.* 1989;8(3):149-153.
- Berland LL, Bluth E. Duplex Doppler ultrasound and color flow. *Radiology.* 1989;173:309.
- Bluth EI, Murphey SM, Hollier LH, Sullivan MA. Color flow Doppler in the evaluation of aortic aneurysms. *Int Angiol.* 1990;9(1):8-10.
- Bluth EI, Merritt CRB. Carotid and vertebral arteries. In: Merritt CRB, ed. *Doppler Color Imaging.* New York: Churchill Livingstone, 1992:61-96.
- Mizrahi S, Hussey JL, Hayes DH, Boudreaux JP, Merritt CR, Bluth EI. Protocol Doppler color flow imaging immediately after kidney transplantation. *South Med J.* 1993;86(10):1126-1128.
- Bluth EI. Carotid arteries. In: Bluth E, Divon M, eds. *Update in Duplex, Power and Color Flow Imaging.* Laurel, MD: American Institute of Ultrasound in Medicine, 1996:43-49.
- Bluth E. Carotid plaque. *J Cardiovascular Ultrasonography.* 1985;2:147.
- Bluth EI, Kay D, Merritt CR, et al. Sonographic characterization of carotid plaque: detection of hemorrhage. *Am J Neuroradiol.* 1986;7(2):311-315.
- Bluth EI, Kay D, Merritt CR, et al. Sonographic characterization of carotid plaque: detection of hemorrhage. *AJR Am J Roentgenol.* 1986;146(5):1061-5.
- Baker JD, Marich KW, Bluth E, et al. Standardized imaging and Doppler criteria for cerebrovascular diagnosis using duplex sonography [abstract]. *J Ultrasound Med.* 1986;5:159.
- Bluth E, Arger P, Benson C, Ralls P, Siegal M. *Ultrasound: A Practical Approach to Clinical Problems.* New York: Thieme, 2000.
- Bluth E, Benson C, Ralls P, Siegal M. *Ultrasound: A Practical Approach to Clinical Problems.* 2nd ed. New York: Thieme, 2007.

This article meets the Accreditation Council for Graduate Medical Education competencies for Patient Care, Medical Knowledge, and Systems-Based Practice.