High-Resolution Ultrasound of Inflammatory Bowel Disease (IBD)

by Monzer Abu-Yousef, MD, Professor & Director of Ultrasound

IBD can be easily evaluated by ultrasound (US) using high-resolution phased-linear-array transducers with graded compression. Color Doppler (CDS), oral (Fig. 1) & intravenous US contrast enhance US accuracy in diagnosis of IBD.

Acute IBD

The US presentation of Campylobacter ileocolitis is that of mild to moderate mucosal & submucosal bowel wall thickening (BWT) (Fig. 2), while Yersenia ileocolitis presents with severe cecal & terminal ileal BWT & mesenteric lymphadenopathy. C-Deficile colitis is associated with chronic use of broad spectrum antibiotics. US shows diffuse multilayered BWT. Neutropenic typhilitis is often seen in immune-compromised patients. US shows diffuse mucosal & submucosal cecal BWT. Differentiation between these conditions depends on the history & stool culture. Diverticulitis presents with acute LLQ pain. US shows inflamed diverticula, thickening of the muscularis propria & abscess formation (Fig. 3). US sensitivity is 85%, specificity 80%, PPV 76% & NPV 88%.

Chronic IBD

Crohn disease (CD) & ulcerative colitis (UC) account for the majority of chronic IBD, with a prevalence of 1%. US shows diffuse BWT of terminal ileum & right colon (Fig. 4). In the early stages of UC, US shows mucosal thickening & ulcerations. Later on, the whole wall may be thickened. CDS shows high vessel density in the involved segments in both conditions. CDS of superior & inferior mesenteric arteries show lower resistive indices, high flow velocities & flow volumes depending on the location of the IBD. Portal vein Doppler
Notes from the Chair

Now is the Time to Become Involved in Organized Radiology

Volunteerism is a part of every day life, whether in our communities, our children’s schools, or at our places of worship. However, many radiologists fail to look beyond their full-time professional practices with regard to becoming involved in local, state, or national radiological organizations. At a time when many of us are working as hard as ever, it is just as important to become involved in organized radiology as it is to become involved in our own medical centers and radiological practices. While there is no monetary reward for such volunteer work, the intellectual stimulation, interaction with experts from around the world, and the ability to make a real difference to the field of radiology—outside of one’s own practice environment—are benefits to the volunteer. Indeed, involvement in organized radiology can be a highly rewarding experience. All major radiological organizations, such as the American College of Radiology, the American Board of Radiology, the Radiological Society of North American, and the American Roentgen Ray Society are highly dependent upon and welcome volunteer radiologists. In addition, the subspecialty organizations are equally receptive. Many radiologists are unaware of the scope of activities that these organizations engage in and the many ways in which they may become involved in them.

The American College of Radiology is the major political and socioeconomic organization for radiology. Radiologists should become members of their own state’s ACR chapter and become involved in local and state chapter ACR activities. Working at the state chapter is an easy way for busy radiologists to become involved in organized radiology and to make an impact locally. Each state chapter sends Counselors and Alternate Counselors to the ACR’s annual council meeting where a myriad of issues affecting current and future radiological practice are debated and determined. On a national level, the ACR offers many general and subspecialty committees and commissions to become involved with, such as aspects of radiological practice that include evaluation for the work that we do (via the AMA CPT coding process), reimbursement issues, and, more recently, sub-referral issues and issues related to the performance of radiological testing by non-radiologists.

The American Board of Radiology has long been responsible for the granting of board certification in radiology and, more recently, the granting of maintenance of certification in radiology. The Board is highly dependent upon volunteers who create questions for the written examinations and who serve as examiners for the oral examination. With the myriad of general and subspecialty radiology societies seeking volunteers for organizational service positions, any individual with a specific interest can find a niche in which to participate. Active, reliable, “team player” volunteers are the lifeblood of organized radiology and will become increasingly critical for sustaining our subspecialty into the future. Volunteerism in organized radiology offers the opportunity to shape the future of our practices and to give back to a specialty that has given us all so much. Radiology and its practitioners are indebted to and dependent upon those radiologists who find time in their lives and busy schedules to carry out volunteer duties on behalf of our specialty.

High-Resolution Ultrasound, continued from page 1

shows high velocities & flow volumes. Both US & CDS play a major role in the diagnosis & follow-up of chronic IBD. They are also highly accurate in the detection of complications of IBD (Fig. 5), but neither is helpful in differentiating CD from UC.

US Studies: In a review of 78 patients (49 IBD; 29 controls) correlating US with the clinical, endoscopic & histologic findings, there was statistically significant correlation between BWT & activity in severe IBD, with a sensitivity of 77% & specificity of 83%.1 In another study of 38 patients & 8 controls, US was found to be 88% sensitive & 93% specific in comparison to ileocolonoscopy, using 2 mm as upper limits of normal for BWT.2 There was no significant difference between mean BWT in UC & CD, however. In a study of 59 patients with suspected CD, US sensitivity was 95%, specificity 93%, accuracy 93%; PPV 90% & NPV of 95%, using enteroclysis as the gold standard.3 Compared to radiography &/or colonoscopy, US sensitivity was found to be 86% in CD & 89% in UC, but was not found to be helpful in differentiating the 2 entities.4 In an in-vitro study of resected normal & IBD specimens in 18 patients, US was found to be accurate in differentiating colitis from normal, but not in differentiating CD from UC.5 In a study of 102 CD patients, the sensitivity of conventional US was found to be 91% compared to Golytely-enhanced US of 96%.6 Additionally, oral contrast US was more sensitive than conventional US in detecting strictures, 89% vs 74%, respectively. In a study of 213 patients with CD, strictures detection

(continued on next page)
High-Resolution Ultrasound, continued from previous page

sensitivity for US was 100%, specificity of 91%; fistulas detection sensitivity of 87% with a specificity of 90% & abscess detection sensitivity of 100% with a specificity of 92%. US accuracy in detecting active IBD of the terminal ileum & colon was also found to be higher than that of MR, 89% vs 73%, respectively, while both US & MRI accuracy was better in UC than in CD.

Doppler Studies: In a Doppler study of 45 IBD patients & 45 controls, portal vein mean velocity was found to be significantly higher in patients with active IBD vs inactive disease & controls. SMA RI was found to be significantly lower in active vs controls & inactive UC, but there was no significant difference vs inactive CD. In a study of 85 active & 34 inactive CD segments in 92 patients, BWT of > 5-mm & high vessel density on CDS was found to have a P-value of < 0.001 in differentiating activity from inactivity. In a study assessing the value of US & CDS in treatment monitoring, US & Doppler grades agreed on change direction in 91% in patients undergoing treatment for IBD. Additionally, the absence of CDS signal in a segment with BWT was highly suggestive of ischemia. In a different study the absence of CDS flow signals or high resistive indices in thickened bowel segments also suggested ischemia. Power Doppler was also found to be more sensitive than CDS in detecting inflamed segments in CD & in detecting fistulas. They also found US IV US contrast agents to improve CDS sensitivity.

Summary
US is accurate in the diagnosis of acute IBD & in differentiating surgical conditions such as appendicitis from medical conditions such as acute small & large bowel inflammatory disease. In chronic IBD, US diagnosis depends on BWT & BW echotexture & CDS diagnosis depends on bowel wall vascular density & inflow & outflow characteristics. Both are accurate in diagnosis of IBD, in monitoring disease activity during treatment & detecting complications of chronic IBD. CDS is also accurate in differentiating IBD from bowel ischemia & functional bowel syndromes. US & CDS may not be helpful in differentiating the different IBD causes, however. The accuracy of US & CDS can be enhanced by oral & IV contrast agents.

REFERENCES
Over the last decade, the application of radiofrequency ablation (RFA) for the treatment of neoplasms has significantly increased. This became possible because of the level of sophistication of cross-sectional imaging modalities achieved by the early 1990s. In addition, advances in RFA technology have enhanced the applicability of this technique for treating more patients with less-invasive methods, as well as increased aggressiveness in treating malignancies, both for cure and for palliation.

RFA creates foci of dead tissue by induction of coagulation necrosis via application of lethal heat to the tissue. To simplify, RFA cooks tissue. Unlike the Bovie device, in which the device tip itself is heated and placed on tissue, RFA consists of passing an alternating current through an electrode into the tissue.

Osteoid osteoma is a benign bone tumor characterized by a nidus, composed of a variably calcified meshwork of bony trabeculae on a background of fibrous, vascular, and nerve tissue. The radiologist’s role in the management of this condition has evolved from simply confirming the diagnosis of osteoid osteoma to curing the abnormality. RFA of osteoid osteoma typically begins with CT-guided biopsies to place a thin (21 – 14 gauge) electrode into the target tissue that is the nidus. Unlike RFA of many intra-abdominal lesions, RFA in bones requires that access be created by a biopsy device or drill. One must plan the approach appropriately to allow a perpendicular impact of the access device on the bone and to avoid vital structure. The radiofrequency electrode is passed into the osteoid osteoma, and care should be taken to place the electrode in the nidus of the osteoid osteoma. RFA is performed using temperature control, achieving 90°C at the tip for 4 to 6 minutes. Patients can bear weight immediately, and activities need be limited only in extreme cases. Patients are typically pain free in a few days to a week and need no imaging follow-up unless symptoms recur. In addition, RFA can play a part in a multi-modal approach to reaching palliation of pain and shorten the weeks to successful pain relief for skeletal metastasis.

RFA of musculoskeletal lesions has made great strides in the last decades. RFA has become the treatment of choice in most cases of osteoid osteoma. Furthermore, this procedure is safe, minimally invasive, and an effective treatment for the skeletal metastasis at its primary goal of palliating pain.
Dr. Stanford is a true Iowan, born and raised in Cedar Rapids. His undergraduate experience (he is a Registered Pharmacist) and his medical degree came from The University of Iowa. He was thereafter a resident in General Surgery at University of Iowa Hospitals and Clinics and subsequently a trainee in Cardiothoracic Surgery at our institution.

After completing his training, Dr. Stanford accepted a position with the U.S. Air Force and served as a cardiothoracic surgeon. During most of his time with the Air Force, he was Chair of the Cardiothoracic Surgery Department at Wilford Hall in the U.S. Air Force Medical Center at San Antonio, Texas, a position he held until his retirement from the service in 1980. Besides being responsible for advanced cardiothoracic surgery at Wilford Hall, Dr. Stanford also trained many residents in thoracic surgery for the Air Force. He had multiple other duties throughout this period, such as being the Air Force Representative to the National Institutes of Health’s Surgical Studies Section. He was concomitantly a Clinical Professor of Surgery at the University of Texas Health Science Center in San Antonio, where he was involved in the training program and actively participated in clinical research at that institution.

In 1980, Dr. Stanford retired from the Air Force and entered private practice in Miami, Florida. For a variety of circumstances, that was not an ideal situation for him and he began a new career in radiology.

From 1982 through 1985, Dr. Stanford was a resident in Diagnostic Radiology at University of Iowa Hospitals and Clinics. He was one of our most enthusiastic and active residents. After completion of his residency, he accepted a position on the faculty with the Department of Radiology, where he became Chief of the Cardiac Section of the Department, an appointment he held until his recent move into phased retirement. His advancement through the academic ranks was rapid, and he became a full Professor in 1991.

Dr. Stanford’s career here, in addition to training residents, being responsible for clinical cardiac and test studies and research, centered around the use of electron-beam CT for cardiac imaging. He has authored over 170 papers and 41 book chapters. He has been the recipient of several federal, state and commercial grants. He is considered a world expert in cardiac imaging, and is still on the lecture circuit, even though he is in phased retirement.

Dr. Stanford belongs to and has held offices in numerous professional organizations. He has received the Gold Medal of the Iowa Radiological Society, given to members with distinguished careers.

Bill and Marlene Stanford have been married for 49 years. They have four children and nine grandchildren (including a set of twins and another of quadruplets).

All of us in Radiology are proud of Dr. Stanford for his distinguished career, representing The University of Iowa and himself at the national and international level.

by E.A. Franken, Jr., M.D.

2004 Annual Meeting of the Radiological Society of North America

Vicki Liu-Chiu, MD, Laurie Fajardo, MD, Lee Chiu, MD

Steve Baker, Alan Stolpen, MD, John Haller, PhD

Wilbur Smith, MD, Tony Franken, MD, Yutaka Sato, MD

James Hurley, Cindy Vest, Sam Frangi, MD

William Yuh, MD

William Stanford, M.D.

Askar Qalbani, MD, Fahima Qalbani, MD

Bhaskaro Rao, MD, Monzer Abu-Yousef, MD, Farida Abu-Yousef

Mark Doyscher, MD

Bruce Monson, MD, Edwin van Beek, MD, Rob Danielson, MD

Photos courtesy of Nancy Harney and Lee Chiu, MD
Welcome New Faculty!

**JINSUH KIM, MD, PhD.** joined the Department of Radiology as a Visiting Assistant Professor in the Neuroradiology section. Dr. Kim received his M.D. from Soonchunhyang University, Seoul, Korea, and completed his residency in Radiology at Asan Medical Center, Seoul, Korea. Prior to his appointment at UIHC, he was a Senior Scientist in the Department of Radiology at the University of Wisconsin.

**HIDEFUMI MIMURA, MD, PhD.** joined the Department of Radiology as a Visiting Assistant Professor. He received his medical and Radiology residency training at Okayama University Medical School, Okayama, Japan, and most recently was an Associate Professor at Okayama University Medical School. Dr. Mimura’s subspecialty area is Interventional Radiology.

**AKIHIRO NISHIE, MD.** Visiting Assistant Professor, completed both his medical training and Radiology residency at Kyushu University, Fukuoka, Japan. Prior to his appointment at UIHC, he was a staff radiologist at Kyushu University. Dr. Nishie joins the Body Imaging section of the Diagnostic Radiology division.

**JEONG MI PARK, MD, PhD.** joined the Department of Radiology as Clinical Professor and Director of Mammography in Breast Imaging. She completed her medical education and Radiology residency at Seoul National University, Seoul, Korea. Prior to her appointment at UIHC, Dr. Park was an Associate Professor at the University of Wisconsin.

In addition to our new faculty appointments, we would also like to welcome the following fellows:

**BODY IMAGING**

Aaron Dagit, DO, Fellow-Associate
Kelli Jo Andresen, MD, Fellow-Associate

**INTERVENTIONAL**

Vikas Jain, MD, Fellow
Sugoto Mukherjee, MD, Fellow

**MUSCULOSKELETAL**

Matthew Berst, MD, Fellow-Associate
Joseph Burns, MD, Fellow-Associate
Eric Callaghan, MD, Fellow-Associate
Maheen Rajput, MD, Fellow

**NEUROINTERVENTIONAL**

Jerry Kovoor, MD, Fellow

**NEURORADIOLOGY**

Theodore Donta, MD, Fellow
Bruno Policeni, MD, Fellow

**NUCLEAR MEDICINE**

Feng Qing, MD, Fellow

**PEDIATRIC**

Megha Garg, MD, Fellow
Honors & Awards

Monzer Abu-Yousef, MD
- Awarded the Krabbenhoft, 2004-2005 Best Teacher Award, by the Department of Radiology, University of Iowa
- Invited as an examiner for the American Board of Radiology oral examination in Louisville, Kentucky, June 4-8, 2005
- Appointed as Moderator for the GI US categorical course, annual AIUM meeting, Orlando, FL, June 19-22, 2005
- Served as GU abstract reviewer for the 50th AIUM annual meeting

Twyla Bartel, DO

D. Lee Bennett, MD
- Elected to the Rules Committee of the Society of Skeletal Radiology
- Elected as a Councilor to the American College of Radiology
- Appointed as Moderator, Musculoskeletal (Arthritic Diseases and Related Conditions) Scientific Paper Session #SSA22, Radiological Society of North America 90th Annual Meeting, Chicago, IL, Nov-Dec, 2004

Georges Y. El-Khoury, MD
- Elected by his peers for inclusion in Best Doctors in America®
- Examiner, American Board of Radiology, June 2005

Laurie L. Fajardo, MD
- Awarded an MBA degree from the Johns Hopkins School of Business (May 2005)

Jafar Golzarian, MD
- Awarded clinical initiative from The New Clinical Initiative Business Council and Donna Katen-Bahensky to develop the Fibroid Clinic at UIHC in recognition of its “exceptional potential to serve the larger Iowa population using a multidisciplinary, comprehensive state-of-the-art approach to the treatment of fibroid disease.” Submitted by Drs. Jafar Golzarian (Radiology) and Jill Vibhakar (Obstetrics and Gynecology). Supported by Drs. Laurie Fajardo and Shiliang Sun (Radiology), and Drs. Jennifer Niebyl and Noelle Bowdler (Obstetrics and Gynecology)
- Guest editor for special issue of Techniques in Vascular and Interventional Radiology on Update in Endografts

Geetika Khanna, MD

Mark T. Madsen, PhD
- Elected President of the Computer and Instrumentation Council of the Society of Nuclear Medicine, 2005

Brian F. Mullan, MD
- Finalist, 2005 M4 Teacher of the Year, Carver College of Medicine
- Chair, Strategic Planning Committee Education Design Team, Carver College of Medicine

James A. Ponto, MS, RPh, BCNP
- Appointed to United States Pharmacopeia 2005-2010 Radiopharmaceutical Information Expert Committee

Laura L. Boles Ponto, PhD
- Appointed to United States Pharmacopeia 2005-2010 Radiopharmaceutical Information Expert Committee

Axel Ruprecht, DDS
- Recipient of the Outstanding Service Award of the Iowa Dental Association, May 2005
- Appointed Reviewer for the Journal of the American Dental Association

William Stanford, MD
- Presiding Officer for “CT in Cardiac Imaging” session at the American College of Cardiology Annual Meeting, Orlando, FL, March 6-9, 2005

Edwin J.R. van Beek, MD
- Elected Editor for Imaging Decisions
- Elected Chair for Working Group on Hyperpolarized Noble Gases, International Society for Magnetic Resonance in Medicine

Ge Wang, PhD
- Appointed Founding Editor-in-Chief for the International Journal of Biomedical Imaging, June 2005
UI Department of Radiology Wins Awards at RSNA & ASNR Annual Meetings


Cum Laude Award

Certificate of Merit
- Yee NK, Smoker WRK, Gentry LR, Reede DL, Nerad J. “Vascular lesions of the orbit: more than meets the eye.”

American Society of Neuroradiology 43rd Annual Meeting, Toronto, Canada, May 21-27, 2005

Cum Laude Award
- Kanekar S, Smoker WRK, Moritani T, Lee HK, Kademian J. “‘Bright and White’ deep gray matter nuclei.”
- Bajwa Z, Pivawer G, Reede DL, Smoker WRK, Gentry LG, Holliday RA. “‘Doctor! What is this bump on my head?’: Evaluation of lesions presenting in the scalp and calvarium.”

2004 Employee of the Year
Blaze Rosene, Equipment Specialist in Radiology Engineering, was voted 2004 Employee of the Year. Blaze is “very knowledgeable about all the equipment in the department. He is always willing to answer your questions and never makes you feel that it is a stupid question. He is always there within minutes to help you with problems or questions about the equipment with a smile on his face.”
Congratulations, Blaze!

Service Awards 2004

<table>
<thead>
<tr>
<th>Years</th>
<th>Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Jerry McAtee</td>
</tr>
<tr>
<td></td>
<td>Adam Kruse</td>
</tr>
<tr>
<td></td>
<td>Annette Henderson</td>
</tr>
<tr>
<td></td>
<td>Jungfeng Guo</td>
</tr>
<tr>
<td></td>
<td>Dean Clermont</td>
</tr>
<tr>
<td>10</td>
<td>Patricia Grady</td>
</tr>
<tr>
<td></td>
<td>Janice Cook-Granroth</td>
</tr>
<tr>
<td></td>
<td>Beth Wombacher</td>
</tr>
<tr>
<td>15</td>
<td>Stephanie Ellingson</td>
</tr>
<tr>
<td></td>
<td>Ann Hilgendorf</td>
</tr>
<tr>
<td></td>
<td>Greg Kelly</td>
</tr>
<tr>
<td></td>
<td>Blair Klinefelter</td>
</tr>
<tr>
<td></td>
<td>Jeffrey Murguia</td>
</tr>
<tr>
<td></td>
<td>Blaze Rosene</td>
</tr>
<tr>
<td></td>
<td>Tamara Wilson</td>
</tr>
<tr>
<td>20</td>
<td>Scot Heery</td>
</tr>
<tr>
<td></td>
<td>John Richmond</td>
</tr>
<tr>
<td>25</td>
<td>Mary Nelson</td>
</tr>
<tr>
<td></td>
<td>Patricia Zander-Hubing</td>
</tr>
</tbody>
</table>
The print version of this page contains a listing of 2004 contributors to the Department of Radiology. If you wish to receive a print copy, please contact Nichole Jenkins at (319) 353-8690. Thank you.
Publications

ARTICLES


Scientific Presentations

Scientific Presentations, continued from previous page


Visiting Professors

- El-Khoury GY. Cervical spine trauma. Broadlawns Medical Center, Des Moines, IA, May 19, 2005.

• van Beek EJR. Lecture. State University of Groningen, The Netherlands, Feb. 8, 2005.

**Invited Speakers**

• El-Khoury GY. Recent advances in the imaging of osteoarthritis. 15th Annual Iowa Rheumatology Symposium, Iowa City, IA, May 7, 2004.
• Golzarian J. Carotid stenting: state of the art. Shiraz University of Medicine, Shiraz, Nov. 23, 2004.
• Golzarian J. Surveillance des anevrismes de l’aorte trait par voie endovasculaire. 3eme Journees francophones d’imagerie cardio vasculaires (3rd French speaking days of cardiovascular imaging and treatment). Lausanne, Switzerland, June 3-5, 2005.
• Graham MM. Normal CT anatomy of head and neck, CT head and neck malignancies. CT for the Nuclear Medicine Professional, Houston, TX, November 13-14, 2004.
• Graham MM. PET/CT imaging of the head and neck. 2005 Mid-Winter Educational Symposium, Society of Nuclear Medicine, Wesley Chapel, FL, Jan. 29-30, 2005.
• Graham MM. Comparative PET/CT imaging – lung cancer staging. Central Chapter of the Society of Nuclear Medicine 50th Anniversary Annual Meeting, Chicago, IL, April 1-3, 2005.
• Graham MM. PET/CT: Head and neck. 2005 Pacific Northwest Chapter of the Society of Nuclear Medicine, Coeur d’Alene, ID, April 9-10, 2005.
• van Beek EJR. CT for venous thromboembolism. European Congress of Radiology, Vienna, Austria, March 5, 2005.
• van Beek EJR. Cardiac and pericardiac neoplasms. European Congress of Radiology, Vienna, Austria, March 6, 2005.

**Invited / Refresher Course Faculty**


El-Khoury GY. Does MDCT with MPR eliminate the challenge of specialized extremity positioning? 7th Annual International Symposium on Multidetector-Row CT, San Francisco, CA, June 15-18, 2005


El-Khoury GY. Trauma of the axial skeleton. 37th International Diagnostic Course, Davos, Switzerland, April 2-8, 2005.


El-Khoury GY. Who benefits from 3D rendering of musculoskeletal CT? 7th Annual International Symposium on Multidetector-Row CT, San Francisco, CA, June 15-18, 2005


Golzarian J. 1ères Journées Francophones d’imagerie cardiovasculaire diagnostique et thérapeutique: Co-organizer, Montreal, June 19-23, 2001


Mukherjee, S., Hendrix, M., Kurago, Z., Hsu, M., Dawson, D., Margaryan, N., Ruprecht, A. Expression of cell adhesion molecules in mucosal melanoma. Iowa Section of the American and International Associations for Dental Research, University of Iowa, Iowa City, Feb. 15, 2005.


Ruprecht A. Current guidelines for radiation protection. CDE Program, S.E. Iowa District Dental Society, Fairfield, April 8, 2005.


Ruprecht A. Unusual radiographic findings. The University of Florida, Gainesville, January 24, 2005.

Ruprecht A. Vision and perception: WYSIWYG…or is it? CDE Program, S.E. Iowa District Dental Society, Fairfield, IA, April 8, 2005


Scientific Posters, continued from previous page


Grants

- Daniel Kahn, MD (Project Director); G. Leonard Watkins, PhD: “Phase I open label study of single dose rhenium Re 188 P2045 in patients with lung cancer who have received prior chemotherapy.” (Berlex Laboratories, Inc.) $516,382

- Timothy Tewson, PhD (Project Director); Michael M. Graham, PhD, MD: “The 16th International Symposium on Radiopharmaceutical Chemistry.” (US Department of Energy) $25,000

- Timothy Tewson, PhD (Project Director); Michael M. Graham, PhD, MD, Richard Hichwa, PhD, Malik Juweid, MD, Mark Madsen, PhD, Timothy Tewson, PhD: “16th International Symposium on Radiopharmaceutical Chemistry.” (NIH) $10,000

- Geoffrey McLennan, MD (Project Director); Michael M. Graham, PhD, MD: “Lung image database with pathologic correlates.” (NIH/NCI) $1,520,330

- George Weiner, MD (Project Director); Michael M. Graham, PhD, MD, Richard Hichwa, PhD, Malik Juweid, MD, Mark Madsen, PhD, Timothy Tewson, PhD: “Lymphoma specialized program of research excellence (SPORE).” (NIH) $11,505,241

- George Weiner, MD (Project Director); Richard Hichwa, PhD: “Cancer center support grant (CCSG).” (NIH) $10,370,489

- Robert Block, PhD (Project Director); Michael M. Graham, PhD, MD, Richard Hichwa, PhD, Laura L. Boles Ponto, PhD, G. Leonard Watkins, PhD: “Brain development of adolescent marijuana users.” (NIH) $2,049,637

- Geetika Khanna, MD (Project Director); Yutaka Sato, MD, Michael M. Graham, PhD, MD: “ACRIN 6660: Whole-body MRI in the evaluation of pediatric malignancies.” (NIH) $41,700

- Nancy Andreasen, MD, PhD (Project Director); Richard Hichwa, PhD, Laura L. Boles Ponto, PhD: “Brain imaging in the major psychoses: functional imaging studies.” (NIH) $4,743,455

- Nancy Andreasen, MD, PhD (Project Director); Richard Hichwa, PhD, Laura L. Boles Ponto, PhD, G. Leonard Watkins, PhD: “Research training: major psychoses & clinical neurobiology.” (NIH) $4,034,841

- David Moser, PhD (Project Director); Richard Hichwa, PhD, Yusuf Menda, MD, Laura L. Boles Ponto, PhD, G. Leonard Watkins, PhD: “Cerebro/peripheral vascular function to cognition.” (NIH) $120,950

- Ge Wang, PhD (Project Director); Mark Madsen, PhD, Shiying Zhao, PhD: “Cone-beam methods for dynamic volumetric x-ray CT.” (NIH/NIDCR) $1,408,525