



## RF Ablation

By Govindarajan Narayanan, M.D.,

John A. Ferretti, M.D., Paul L. Vitulli, D.O.

Division of Interventional Radiology

The Division of Interventional Radiology at Stony Brook University Hospital is excited to announce the availability of a new treatment option for treating tumors. Radiofrequency ablation or RF ablation uses heat as a tool in the treatment of tumors. RF ablation can be performed laparoscopically in the operating room. Now the procedure can be done percutaneously in the Interventional Radiology Suite using imaging guidance such as CAT scan or Ultrasound.

High frequency alternating current is delivered to the tumor through an electrode that has been precisely placed in the tumor using imaging guidance. This agitates the water molecules in the tissue generating frictional heat, which kills the tumor cells.

The setup is fairly simple with the patient placed on the CAT scanner. Grounding pads are placed on the patient's thigh or back which is connected to the generator and the electrode within the tumor, completing the electrical circuit. Once the position of the electrode is confirmed, the generator can be turned on to deliver the RF energy.

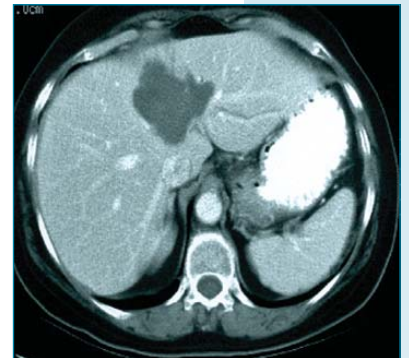
### Setup

The procedure is performed using moderate sedation or under general anesthesia. Contraindications include pregnancy, excessive tumor burden, uncorrectable coagulopathy or active infection.

The procedure time varies according to the size and type of tumor treated. The ablated tumor cells are not removed. They are gradually replaced by fibrosis and scar tissue. When successful, the treated tumor shrinks in the following months.

RF ablation can be used in treating tumors involving the liver, kidneys, bone (especially osteoid osteoma), adrenals, and pain palliation. It may also have a role in the treatment of tumors involving the breast and prostate.

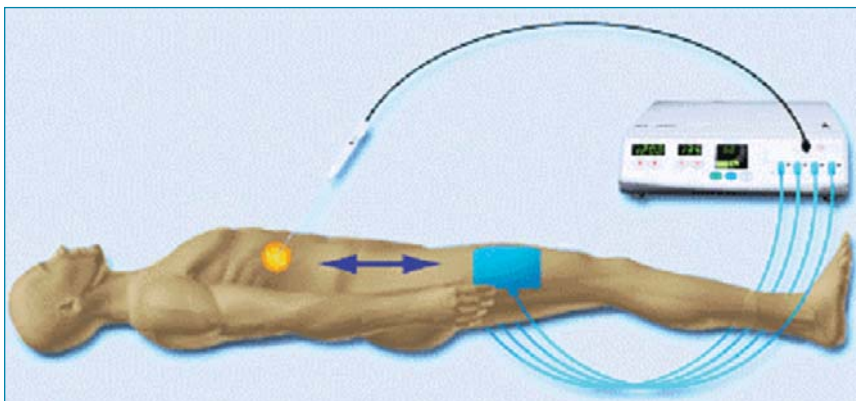
The liver is one of the organs where there is a tremendous amount of experience in the use of RF ablation. Primary liver tumor is the most common solid tumor worldwide and hepatocellular carcinoma accounts for 84% of primary liver cancer in the USA. Surgical resection is performed on patients with resectable tumors. Several surgical series have reported 5 year survival rates of 25-40% with careful patient selection<sup>1-3</sup>, but 85-90% are not candidates for surgical resection.



Percutaneous RF ablation can be used in patients who are poor surgical candidates and also in conjunction with other treatment modalities.

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There are multiple series in which results of RF ablation of hepatic malignancies have been described.<sup>4,5</sup>

RF ablation is ideal for treatment of patients with nonresectable primary lung tumors and multiple lesions in one or both lungs. RF ablation can preserve more lung function than surgery,

Pre and post RF ablation of a liver tumor



# Chairman's Corner

by Donald P. Harrington, M.D., F.A.C.R.



This issue of the "Radiology Letter" is very exciting as it reflects the commitment of the Department to make new cutting edge technologies available to our community physicians. As Chairman of a Radiology Department, it is always a pleasure to introduce new technologies and modalities. It is particularly apropos as this is our 25th Anniversary of the opening of University Hospital to present cutting edge technology for such a young institution. This is due to the vision and commitment of the President of the University, the Dean of the School of Medicine and the Chief Executive Officer of the University Hospital.

Radiofrequency Ablation is a treatment option for tumors and is another tool available to oncologists of our Long Island Cancer Center. What makes this especially exciting is the fact that this procedure can be done percutaneously in the Interventional Radiology Suite, does not require an operation and sometimes can be performed without anesthesia.

Cardiac MRI has become one of the most valuable diagnostic tools for heart disease, especially over the past 5 years. With joint effort of the radiologists and the cardiologists, we can bring state-of-the-art diagnostic techniques to our patients in the form of non-invasive procedures. In addition, the MRI exams do not expose the patient to ionizing radiation and is therefore safer for patients.

While new cutting edge technologies are an exciting addition to our imaging efforts, we do not want to forget those we already do well. To that end, we are moving to expand access to ultrasound-guided fine needle aspiration thyroid biopsy procedure that is offered at Stony Brook. We believe that the community will be better served if we can expand this service.

As you peruse the names of our radiologists and research faculty in this issue, I encourage you to give them a call and inquire how we may be able to better assist you in providing clinical services to your patients. We are here to serve the needs of our constituents and welcome your comments and suggestions. This is an exciting time to be a part of the science of imaging.

## THE RADIOLOGY LETTER

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Donald P. Harrington, M.D. *Chairman*  
Michael J. Cortegiano *Administrator*  
Christine R. Hubbard *Editor and Staff Writer*

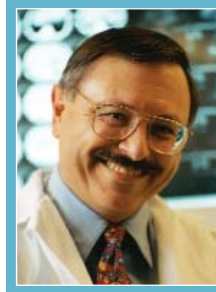
# Research News

Virtual colonoscopy research started its first phantom experiment in August of 1994 and first patient trial in December of 1995 at Stony Brook University Hospital. The procedure was approved by the Federal Drug Administration (FDA) for use in November of 2000, and has shown a comparable detection of colonic polyps and growths, in mimicking the procedure of optical colonoscopy. It is safe, nearly non-invasive, more patient-acceptable and cost-effective and therefore, a potential screening method for examination of the entire colon. It is hoped that it will save many lives by detecting the polyps before they become cancerous.

Jerome Liang, Ph.D. and his peer colleagues across the nation edited a special issue on *Virtual Endoscopy* for the Journal of IEEE Transactions on Medical Imaging. Dr. Liang serves on the Editorial Board since early 1999.

Jerome Liang, Ph.D. delivered a talk on "Virtual Colonoscopy - An information processing in medical imaging" at the 3rd International Conference on Image and Graphics at Hong Kong, China in December of 2004.

# Congratulations



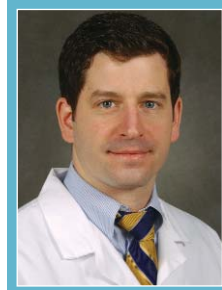
Steven Perlmutter, M.D., F.A.C.R. named Medical Director of Radiology



Maria Wolfe, R.T. named Hospital Director of Radiology and Cardiology



Anthony Indelicato named Associate Hospital Director of Radiology



William Zucconi, D.O. named Chief Resident



Harris Cohen, M.D. named RSNA editorial advisor at the Annual RSNA Meeting in 2004

# Cardiac MRI

By Hong Meng, M.D., Shane DeCamp, R.T., M.R.

Scott McVicker, R.T., M.R.

Since the installation of the state-of-the-art 1.5T and 3T Philips' magnets in the Department of Radiology, we have been focusing on the development of cardiovascular MR imaging service (CMR). This service benefits both pediatric and adult patients with cardiovascular diseases. More than thirty cardiac MRI studies have been performed in patients with various clinical cardiac indications. Both 1.5T and 3T magnets are equipped with a dedicated cardiac surface coil and vector ECG-gating capability. It is also empowered by the advanced cardiac imaging software package, and a workstation where the complex cardiac image analysis and quantification can be made.

We are now able to acquire high quality black blood spine echo images at multiple planes for evaluation of cardiovascular anatomy, cardiac morphology, and intra-cardiac or pericardial diseases (Fig. 1). Velocity encoded flow mapping by phase contrast technique is available to estimate the severity of valve stenosis or regurgitation (Fig. 2). High contrast resolution cine imaging without the administration of contrast media is routinely performed using bright blood gradient echo technique in oblique planes along the true cardiac axes (Fig. 3). Cine imaging provides accurate measurement of ventricular size, wall mass and function, including ejection fraction, end diastolic and systolic volume, wall motion and thickening (Fig. 4). These functional evaluations, plus contrast first pass perfusion imaging, are now being performed at rest, and we are planning the next step for functional and perfusion assessment during pharmacologic stress. Pre-revascularization assessment of myocardial viability has become an important clinical goal. We perform delayed contrast-enhanced MR imaging for the detection of myocardial viability. This is the only technique that is currently able to resolve the

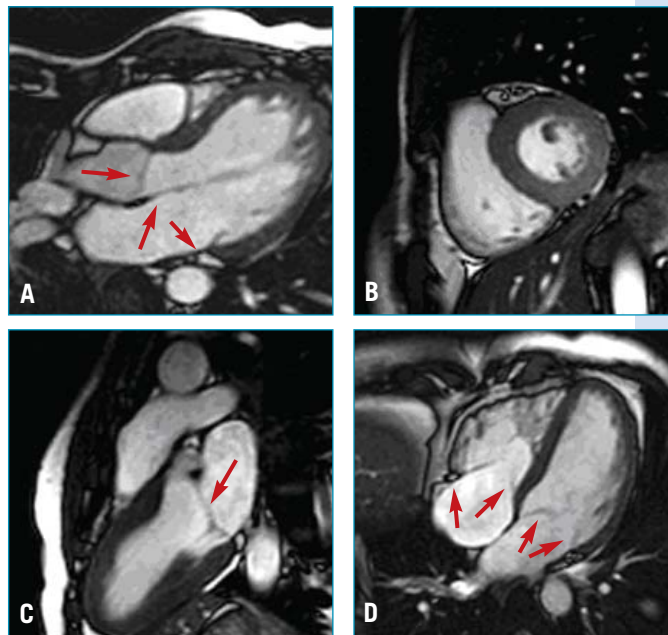


Figure 3. Three chamber view (A) at the level of LVOT, closed AV and open MV (arrows). Short axis (B) through LV and RV. Two-chamber view (C) of LV and LA, closed MV (arrow). Four chamber view, (D) open TV and MV (arrows).

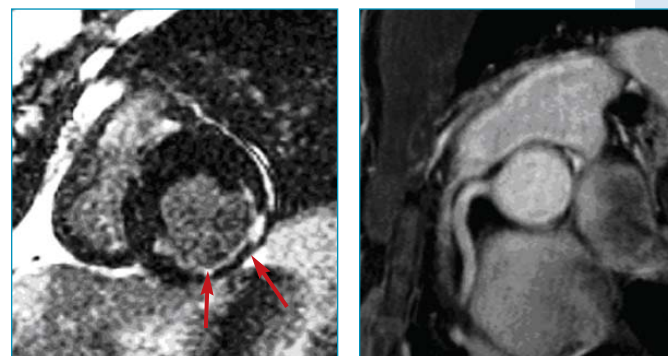


Figure 4. Non-transmural subendocardial infarct enhancement) in the lateral-inferior wall on the delayed contrast viability imaging (arrows).

Figure 5. Non-contrast MRA of RCA using free-breathing motion track technique.

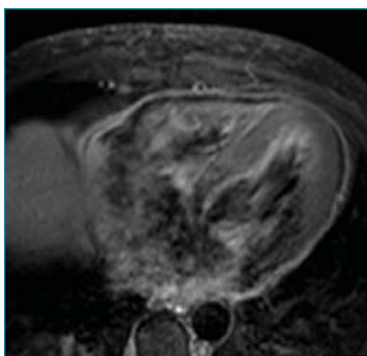


Figure 1. Pericarditis. Pericardium mild thickening and enhancement.



Figure 2. Aortic insufficiency. Aortic regurgitation flow jet towards LV at early diastole.

transmural extent of myocardial infarction due to its superior tissue contrast and spatial resolution. It has been reported that CMR is more sensitive than SPECT technique for detecting subendocardial infarction (Fig. 5).

Patient appointment can be made by calling (631) 444-6919 or 444-2471. Dr. Meng can be reached at (631) 444-8192.



*Squamous cell carcinoma involving right lung*



*36 months post RF ablation*



which is extremely important in patients with decreased lung capacity. In some cases, the patient can potentially be free of disease. In other cases, a significant reduction in tumor volume may be achieved, allowing chemotherapy to be more effective. RF ablation may be used in conjunction with chemotherapy for added benefits. Tumor cells are made more sensitive to heat with chemotherapy, making ablation more effective. Destroying the central portion of tumors can be effectively achieved using RF ablation.<sup>6</sup> It is this area of tumors that does not respond well to chemotherapy because of decreased blood flow. Therefore, the ability to destroy the central tumor using RF ablation is a tremendous advantage in extending life.

RF ablation of Osteoid osteomas under general anesthesia involves placing a bone cutting biopsy needle into the center of the osteoid osteoma using CAT scan guidance. An RF electrode is then placed through the needle and ablations performed for approximately 6-15 minutes. This is sufficient to destroy the small nidus of prostaglandin producing cells. The electrode and the needle are removed and a small bandage is applied to the skin. Cure with one session can be as high as 90%. Rosenthal et al. treated 263 patients with a 91% success rate. The ablated

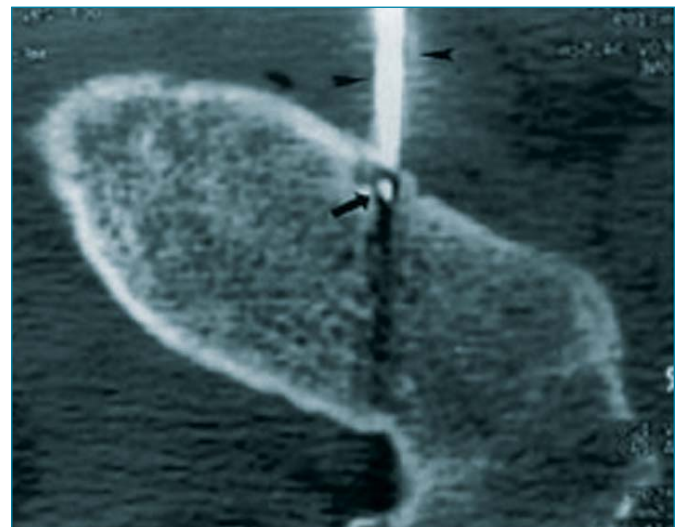
multiple pain syndromes including trigeminal neuralgia, celiac ganglion pain and plantar fasciitis. It has also been used for tumor-related pain. Neurodestruction, decreased interstitial or intratumoral pressure or decreased pressure on adjacent structures may be the mechanism of pain relief in patients with focal tumor pain.

region of bone typically undergoes demineralization after about 6 weeks.

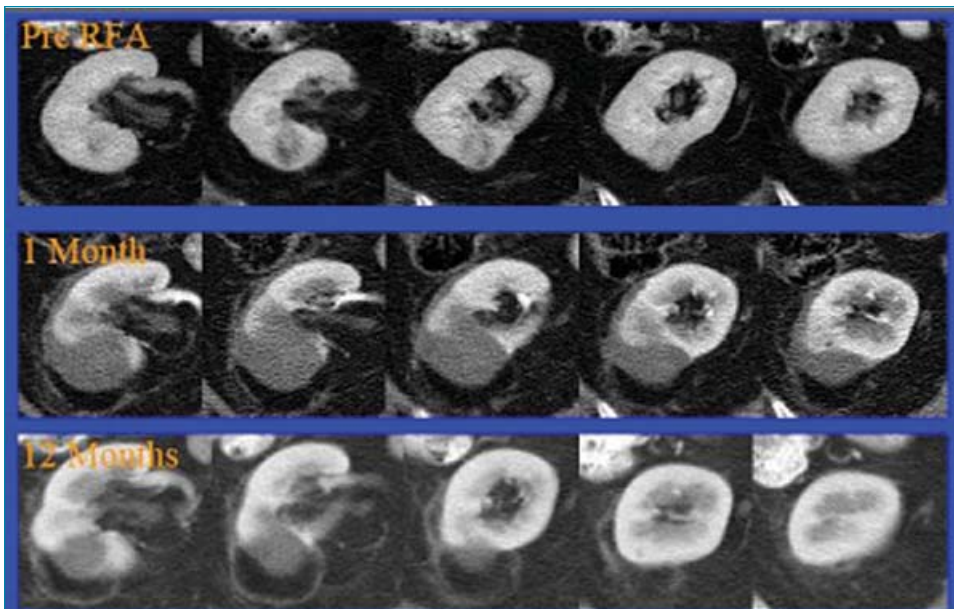
In patients who have failed chemotherapy and radiation, RF ablation can also be used in the palliative treatment of bone metastasis. It helps in pain reduction, reduction of analgesics and improves quality of life.

Although surgical resection is the standard for renal cell carcinoma,<sup>8</sup> RF ablation has a role in patients who are a high surgical risk, multifocal RCC in von Hippel-Lindau, and in patients who refuse surgery.

RF ablation of nerve ganglia has been effective in treating



*RF ablation of Osteoid Osteoma involving the femur*



RF ablation of renal cell carcinoma

Treatment options for adrenal tumors are limited. Chemotherapy and radiation have a limited role in treatment of Adrenocortical carcinoma, although repeated surgical resection may prolong survival. Pheochromocytomas, aldosteronoma and metastatic disease to the adrenal can all be treated with RF ablation with appropriate endocrine evaluation.

According to the study Bruno Fornage et al. published in the April 2004 issue of Radiology<sup>11</sup>, Radio-frequency ablation safely treats small breast tumors and could eventually replace lumpectomy. The study shows its feasibility in the treatment of breast lesions smaller than 2 cm. Fornage and colleagues performed ultrasound-guided RFA on 21 malignant lesions in 20 patients. They used a 15-gauge needle electrode to ablate tumors at 95°C for 15 minutes. The procedure was done before a scheduled lumpectomy or mastectomy. Histopathologic examination confirmed complete ablation in all 21 cases, with no reported adverse effects. The procedure also isn't suitable for every tumor type. Tumors that are ill-defined or associated with a substantial component of ductal carcinoma in situ on core biopsy, are not eligible. In addition, large tumors that have shrunk to a small size during neo adjuvant chemotherapy cannot be treated with the procedure.

Most patients are discharged the same day or the following day after percutaneous RF ablation. Some patients might experience a post tumor destruction syndrome, which includes myalgia, low grade fever and productive cough. Follow up studies include a three phase CT scan and office visit one month post RF ablation. Repeat CT Is obtained at 3 months, and then every 3 months for the first year. PET imaging & serum marker tests may help in equivocal cases.

In conclusion, percutaneous imaging guided RF ablation offers an exciting modality to treat many cancer patients who are nonsurgical candidates. The low cost, low risk benefits combined with the treatment success rates and ability to repeat the procedure, make this a viable alternative in the treatment of these patients.

<sup>1</sup>Fegiz G, Ramacciato, D'Angelo F, et al. Patient selection and factors affecting results following resection of hepatic metastases from colorectal carcinoma. *Int Surgery*. 1991;76:58-63.

<sup>2</sup>Coburn CS, Makowka L, Langer B, Taylor BR, Falk RE. Examination of patient selection and outcome for hepatic resection for metastatic disease. *Surg gynecol Obstet*. 1987;165:239-246.

<sup>3</sup>Lind DS, Parker GA, Horsley JS et al. Formal hepatic resection of colorectal liver metastasis: Ploidy and prognosis. *Ann Surg*. 1992;215:677-684.

<sup>4</sup>Rossi S, Buscarini E, Garbagnati F, et al. Percutaneous treatment of small hepatic tumors by an expandable RF needle electrode. *AJR Am J Roentgenol* 1998;170:1015-1022.

<sup>5</sup>Livarghi T, Meloni F, Goldberg SN, Lazzaroni S, Solbiati L, Gazelle GS, Hepatocellular carcinoma:radio-frequency ablation of medium and large lesions. *Radiology* 2000;214:761-768.

<sup>6</sup>Akeobshi M, Yamakado K. Percutaneous RF ablation of lung neoplasms. *JVIR* 2004;15(5):463-470.

<sup>7</sup>Rosenthal DI, Hornieck FJ, Torriani M, Gebhardt MC, Mankin HJ. Osteoid Osteoma: Percutaneous treatment with radiofrequency energy. *Radiology* 2003;229:171-175.

<sup>8</sup>Motzer RJ, Bander NH, Nanus DM. Renal cell carcinoma. *New England Journal of Medicine* 1996;335:865.

<sup>9</sup>Pavlovich CP, Waltheer MM, Choyke PL, Paulter SE, Chang R, Linehan WM, Wood BJ. Percutaneous RF ablation of small renal tumors: Initial results. *J Urology* 2002; 167:10-15.

<sup>10</sup>Wood BJ, Abraham J, Hvizda JL, Alexander HR, Fojo T. Radiofrequency ablation of adrenal tumors and adrenocortical carcinoma metastases. *Cancer* 2003;554-60.

<sup>11</sup>Bruno D. Fornage, Nour Sneige, Merrick I. Ross, Attiqa N. Mirza, Henry M. Kuerer, Beth S. Edeiken, Frederick C. Ames, Lisa A. Newman, Gildy V. Babiera, and S. Eval Singletary. Small (2cm) Breast Cancer treated with US-guided Radio-frequency Ablation: Feasibility Study. *Radiology* 2004 231:215-224.

# Ultrasound-Guided Fine Needle Aspiration Thyroid Biopsy

By Steven Perlmutter, M.D., F.A.C.R.,

*Associate Professor of Clinical Radiology*

Erica Posniak, M.D., Assistant Professor of Clinical Radiology

The Department of Radiology each year performs several hundred ultrasound-guided fine needle aspiration biopsies of thyroid masses. This minimally invasive procedure plays a central role in the evaluation of thyroid nodules. It determines if the nodule is benign and can be followed, or if it is malignant (or potentially malignant) and must be surgically removed. Ultrasound-guided fine needle biopsies have significantly reduced the number of thyroid operations because the diagnosis of benign nodules can be made without surgery. Furthermore, when an operation is necessary, the surgeon can plan the ideal procedure because the precise diagnosis is known pre-operatively.

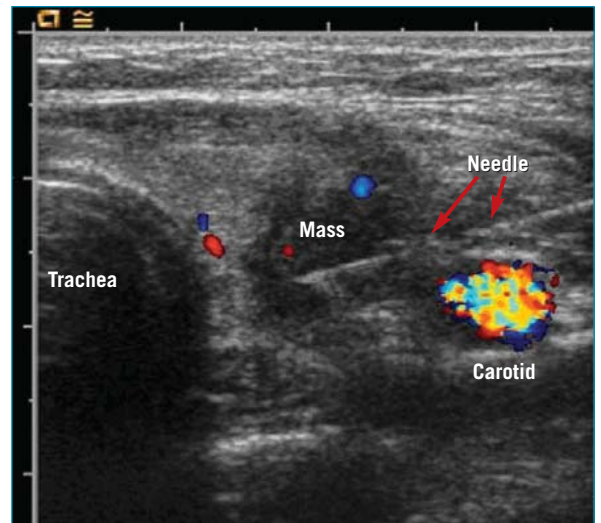
During this minimally invasive procedure, the radiologist aspirates cells from the mass through very thin (25 gauge) needles under real-time ultrasound guidance. Working with an experienced ultrasound technologist, the radiologist can watch the needle glide to the ideal spot in the nodule (such as the thick wall of a cystic thyroid mass) on the ultrasound machine's video monitor. This allows the radiologist to obtain the ideal sample. Because this is done with local anesthesia, most patients experience minimal discomfort and continue with their day's normal activity. One of the advantages available at Stony Brook, and not at many other institutions, is the presence of a skilled cytology technologist during the actual biopsy. The cytology technologist immediately makes slides from the sample and determines within 10-15 minutes if there are sufficient cells in the sample to allow the cytopathologist to later make a definitive diagnosis. In most cases, there are sufficient cells. However, if there are insufficient cells, the radiologist can make one or more additional passes to obtain an adequate sample at that time. At institutions where a cytology technologist is not immediately available to review the slides, it may be necessary to call the patient back on a subsequent day and repeat the biopsy. The presence of a cytology technologist is one of the reasons that we have an outstanding success rate of over 90 percent in making a specific diagnosis. Often, we perform the examination on patients who are referred to us after they had previous unsuccessful attempts at other institutions or offices.

Once the sample is obtained in the Radiology Department, it is carried to the Pathology Department and interpreted by one of the Stony Brook cytopathologists. The cytology results are reported to the referring

healthcare provider within a few days. Not all institutions have pathologists who are expert in interpreting thyroid cytology slides. The cytopathologist is an essential part of the Stony Brook team.

Ultrasound-guided fine needle aspiration can also be used to sample tiny masses in the neck in patients who have had previous surgical removal of thyroid carcinoma to determine if there is a recurrence or spread to lymph nodes in the neck. Fortunately, thyroid carcinoma is usually curable. It is important to diagnose local spread so that it can be treated successfully. We receive referrals from physicians in Nassau, as well as Suffolk County for this sophisticated follow-up. The technique can also be used to diagnose some or other types of neck masses in addition to thyroid masses.

To schedule an appointment for a physician-referred ultrasound-guided fine needle thyroid or neck aspiration biopsy, please call (631) 444-1022.



## Ultrasound Guided Thyroid Fine-Needle Aspiration Biopsy of a Mass

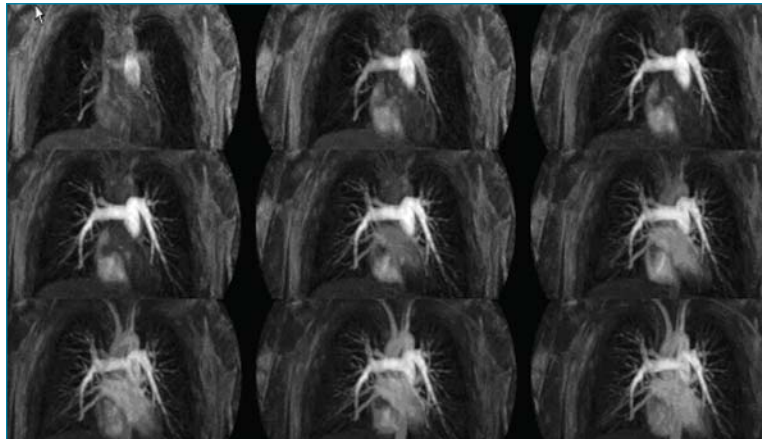
Single frame from a "real time" movie-like sonogram shows the needle (labeled by 2 dotted yellow arrows) gliding safely above the carotid artery (round structure with blood flow shown in color above the label "CAROTID".) The needle tip is in the center of a mass (darker area that contains the label "MASS".) The needle is intentionally stopped before the trachea (dark area that contains the label "TRACHEA".) Slight suction is then applied and cells are drawn up through the hollow needle into a syringe (not shown). The cytology technologist from the Pathology Department immediately makes slides from the aspirated material. These slides are then studied with a microscope to ensure an adequate sample has been obtained. The small round areas of red and blue colors represent vessels in the mass thyroid.

# Time-Resolved Ce-MRA: A New Technique for Dynamic Imaging of the Vasculature

By Hong Meng, MD

Scott McVicker, RT, MR

Contrast-enhanced MR angiography (Ce-MRA) has developed as a highly robust non-invasive technique for evaluation of the vasculature. It produces a single 3D image with high spatial resolution in a breath-hold (about 20 seconds) at a given time after peripheral intravenous contrast injection but little information about flow pattern. With fast imaging technique and advanced software and hardware on our newly installed 1.5T and 3T Philips scanners, much shorter acquisition times are achievable allowing dynamic ultra-fast 3D imaging of the vasculature with high temporal resolution (sub-second to seconds/frame). It demonstrates both vascular anatomy and flow pattern, and provides functional information (blood supply) as well. This new technique further enhances the effectiveness of MRA for evaluation of complex flow patterns such as sequential filling of the true and false lumens in the aortic dissection, the filling and draining pattern of high-flow arteriovenous shunt, endovascular stent-graft leak and retrograde filling in subclavian steal. The concern of scan timing is eliminated and arterial enhancement obtained without venous contamination. Scan timing is sometimes difficult for patients with delayed



*Time-resolved ce-MRA of the thorax. Subtracted 3D datasets with subsequent MIPs, 1.8 seconds/frame, 30 dynamic frames covering a 9 cm thick coronal slab (9 dynamic frame shown).*

filling (cardiac failure, aortic aneurysm or stenosis). It is also true in children who have fast circulation time; only very small contrast dose is administered (few ccs) and breath-holding is not practical. Time-resolved ce-MRA allows dynamic, breathing-independent imaging of the vasculature at frame rates approaching those of conventional angiography.

Patient appointment can be made by calling (631) 444-6919 or (631) 444-2471, and Dr. Meng can be reached at (631) 444-8192.

## Lectures

**John Pile-Spellman, M.D. presented a lecture on “Current and Future Practices in Interventional Neuroradiology.” Dr. Pile-Spellman is a Professor of Radiology and Neurological Surgery and Director of Interventional MRI at the Columbia Presbyterian Medical Center in New York, New York.**

**John Amodio, M.D. presented a lecture on “Renal Masses of Childhood”. Dr. Amodio is an Assistant Professor of Pediatric Radiology at the New York University Medical Center and New York University School of Medicine in New York, New York.**

**Nancy Budorick, M.D. presented a lecture on “Prenatal MRI: Frontier or Folly?” Dr. Budorick is a Professor of Clinical Radiology at the Columbia University Medical Center in New York, New York.**

# RADIOLOGY LETTER

*A Radiologist's Approach to Imaging Vistas* ■ *State University of New York at Stony Brook*

DEPARTMENT OF RADIOLOGY  
Room 120, L4 Health Sciences Center  
State University of New York at Stony Brook  
Stony Brook, New York 11794-8460

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## Faculty & Staff

**Donald P. Harrington, M.D., F.A.C.R.**

*Professor and Chairman of Radiology  
Professor of Biomedical Engineering  
Radiologist-in-Chief*

**Harris L. Cohen, M.D., F.A.C.R.**

*Professor of Radiology  
Associate Chair for Research  
Director of Body Imaging  
Chief, Ultrasound  
Chief, Pediatric Body Imaging*

**Arie E. Kaufman, Ph.D.**

*Professor of Radiology and Computer Science*

**Jerome Z. Liang, Ph.D.**

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*Professor Emeritus of Radiology*

**Zvi H. Oster, M.D.**

*Professor Emeritus of Radiology*

**Robert G. Peyster, M.D.**

*Professor of Radiology and Neurology  
Division of Neuroradiology*

**Terry M. Button, Ph.D.**

*Associate Professor of Clinical Radiology  
Director of the Medical Physics Track in  
Biomedical Engineering  
Director Medical Imaging Technology  
Program in School of Health Technology  
and Management*

**John A. Ferretti, M.D.**

*Associate Professor of Clinical Radiology  
Associate Chair, Quality  
Director, Interventional Radiology  
Chief, Vascular Interventional*

**Paul R. Fisher, M.D.**

*Associate Professor of Clinical Radiology  
and Surgery  
Division of Diagnostic Radiology  
and Breast Imaging  
Director, Breast Imaging*

**Gene R. Gindi, Ph.D.**

*Associate Professor of Radiology and Electrical  
Engineering*

**Elaine S. Gould, M.D.**

*Associate Professor of Clinical Radiology  
Director, Core/Orthopaedic Radiology  
Administrative Director MR*

**James V. Manzione, M.D., D.M.D.**

*Associate Professor of Clinical Radiology and  
Neurological Surgery  
Acting Director, Division of Neuroradiology*

**Steven Perlmutter, M.D., F.A.C.R.**

*Associate Professor of Clinical Radiology  
Medical Director, Department Clinical Service  
Division of Diagnostic Radiology and  
Cross-sectional Imaging  
Director, Residency Program*

**Patricia E. Roche, D.O.**

*Associate Professor of Clinical Radiology  
and Neurology  
Division of Neuroradiology*

**Clemente T. Roque, M.D.**

*Associate Professor of Clinical Radiology  
and Neurosurgery  
Division of Neuroradiology*

**Thomas H. Smith, M.D.**

*Associate Professor of Radiology and Pediatrics  
Division of Diagnostic Radiology  
Chief, Pediatric Radiology*

**Sol Spector, M.D.**

*Associate Professor of Clinical Radiology  
Division of Diagnostic Radiology  
Chief, GI/GU, Emergency*

**Wei Zhao, Ph.D.**

*Associate Professor of Clinical Radiology  
Medical Physicist*

**Corazon J. Cabahug, M.D.**

*Assistant Professor of Clinical Radiology  
Director, Division of Nuclear Medicine*

**Bruce M. Chernofsky, D.O.**

*Assistant Professor of Clinical Radiology  
Division of Neuroradiology*

**Eddie Fiore, M.D.**

*Assistant Professor of Clinical Radiology  
Division of Cross-sectional Imaging*

**Dinko Franceschi, M.D.**

*Assistant Professor of Clinical Radiology  
Division of Nuclear Medicine*

**Margaret Johnstone, M.D.**

*Assistant Professor of Clinical Radiology  
Division of Breast Imaging*

**Seth O. Mankes, M.D.**

*Assistant Professor of Clinical Radiology  
Division of Cross-sectional Imaging*

**Hong Meng, M.D.**

*Assistant Professor of Clinical Radiology  
Division of Cross-sectional Imaging and  
Diagnostic Radiology  
Chief, Body MRI*

**William H. Moore, M.D.**

*Assistant Professor of Clinical Radiology  
Division of Diagnostic Radiology  
Chief of Thoracic Imaging*

**Roxanne B. Palermo, M.D.**

*Assistant Professor of Clinical Radiology  
Division of Breast Imaging and Cross-  
sectional Imaging*

**Erica J. Posniak, M.D.**

*Assistant Professor of Clinical Radiology  
Division of Cross-sectional Imaging*

**Laurette Sauter, M.D.**

*Assistant Professor of Clinical Radiology  
Division of Breast Imaging*

**G. Lucy van de Vegte, M.D.**

*Assistant Professor of Clinical Radiology  
Division of Cross-sectional Imaging*

**Paul Vitulli, D.O.**

*Assistant Professor of Clinical Radiology  
Division of Special Procedures and  
Interventional Radiology*

**Mark Wagshul, Ph.D.**

*Assistant Professor of Clinical Radiology  
Director of MRI Research*

**Zengmin Yan, M.D.**

*Assistant Professor of Clinical Radiology  
Division of Neuroradiology and Cross-  
sectional Imaging*

**Marlene Zawin, M.D.**

*Assistant Professor of Clinical Radiology  
Division of Cross-sectional Imaging  
Chief, Computed Tomography*

**ADMINISTRATIVE STAFF**

**Michael J. Cortegiano**  
*Administrative Officer*

**Patricia George**  
*Medical Practice Plan Administrator*

**Anthony Indelicato**  
*Associate Hospital Director of Radiology*

**Maria Wolfe, R.T.**  
*Hospital Radiology Assistant Director*