AMIGO

Advanced Multi-Modality Image Guided Operating Suite

2012 YEAR IN REVIEW

AMIGO

BWH BRIGHAM AND WOMEN'S HOSPITAL

NATIONAL CENTER FOR IMAGE-GUIDED THERAPY iGT

To the dedicated clinical and administrative team of the

Advanced Multimodality Image Guided Operating Suite

your **service and hard work have made possible a year of…**

groundbreaking research,

innovative medicine, and

life-changing procedures.

We just wanted to take this opportunity to acknowledge the *incredible* things you do, and to say…

Thank You!

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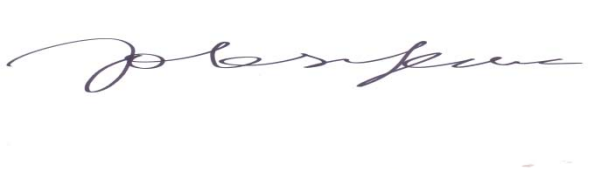
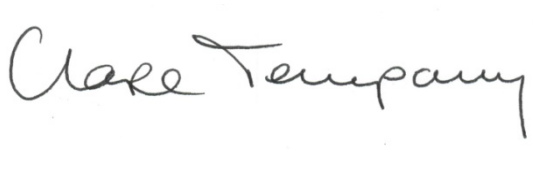
Message From Leadership

Message From Leadership

Over the past year, we have launched a number of new programs for several important conditions that are forwarding the mission of the Advanced Multimodality Image Guided Operating suite to demonstrate that advanced imaging and image-based information may be integrated into surgical and interventional procedures to provide improved clinical outcomes and long term prognosis.

In light of our achievements, we would like to take this opportunity to congratulate and provide a heartfelt thanks to all. It is only through interdisciplinary ***teamwork*** *that successes in AMIGO have been realized. Your hard work, on behalf of our patients and medical innovation continues to be so inspirational. Thank you for all that you do.*





Ferenc Jolesz **Clare Tempany**

Meet the Team

Meet the Team

AMIGO Medical Directors

Ferenc A. Jolesz, MD
Director of MRI and Image Guided Therapy Program

Clare M. Tempany, MD
Vice-Chair for Research, Director of Clinical Focused Ultrasound

Hugh Flanagan, MD
Medical Director, OR / AMIGO

AMIGO Associate Medical Directors

Alexandra Golby, MD
Neurosurgery

Ali Tavakkoli, MD
General and GI Surgery

Kemal Tuncali, MD
Radiology, Abdominal Imaging and Intervention

AMIGO Associate Scientific Directors

Tina Kapur, PhD
Executive Director, Image Guided Therapy

Victor Gerbaudo, PhD, MSHCA
Director, Nuclear Medicine and Molecular Imaging

Meet the Team

AMIGO Core Team

Julia Bousquet
Anesthesia Technologist

Susan Corrigan-Sheehan
Registered Nurse

Janice Fairhurst
Lead MRI Technologist

Sean Jackson
Flow Coordinator

Ray John
Inventory Controller

Angela Kanan
Nurse-in-Charge

Sandra Lawson
Instrument Technician

Meet the Team

Angiography

Radiology Special Procedure Technologists

Lynne Johnson | Marilyn Moriarty | Christine Morello | Stewart Watts

Biomedical Engineering

Clinical Engineers

Jennifer Cofske | Ernst Daniel | Daniel Kacher

Environmental Services

OR Assistants

Jean Dyer | Derrick Smith | Ateyonie Vilnegre

Nuclear Medicine

Technologists

Jolene Fantony | James Semer | William Sticka

Radiology Administration

Marsha O'Neil Doherty
Operations Manager, L1 and Shapiro MRI Services

Stuart Hooton
Administrative Director of MRI

Research / Technology

Nathalie Agar, PhD | Andrij Fedorov, PhD | Noby Hata, PhD

Jayender Jagadeesan, PhD | Ron Kikinis, PhD | Steve Moore, PhD

Isaiah Norton | Lawrence Panych, PhD | Mi-Ae Park, PhD

Ehud Schmidt, PhD | Junichi Tokuda, PhD | Kirby Vosburgh, PhD

Ultrasound

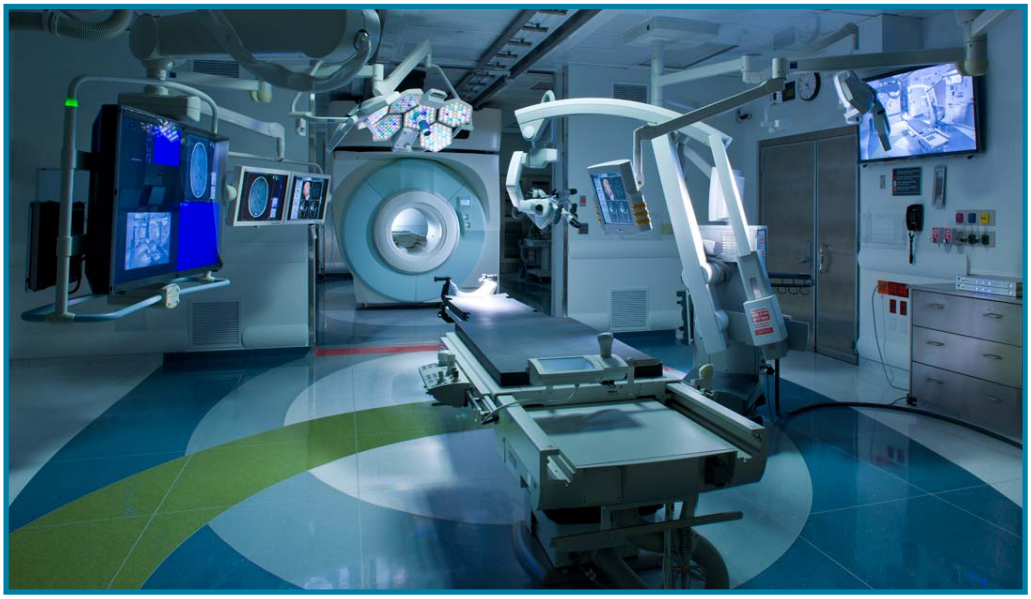
Technologists

Denie Bernier | Yousef Mina | Corey Walsh

Executive Summary

Executive Summary

Programs Launched	**9**
Services Represented	**5**
Overall Volume (Aug. '11 – Dec. '12)	**226**
FY12 Volume (Oct. '11 – Sept. '12)	**176**
▪ Cardiology:	7
▪ Neurosurgery:	38
▪ Radiology:	97
▪ Radiation Oncology:	31
▪ Surgical Oncology:	3



Phase I Programs

Neurosurgery

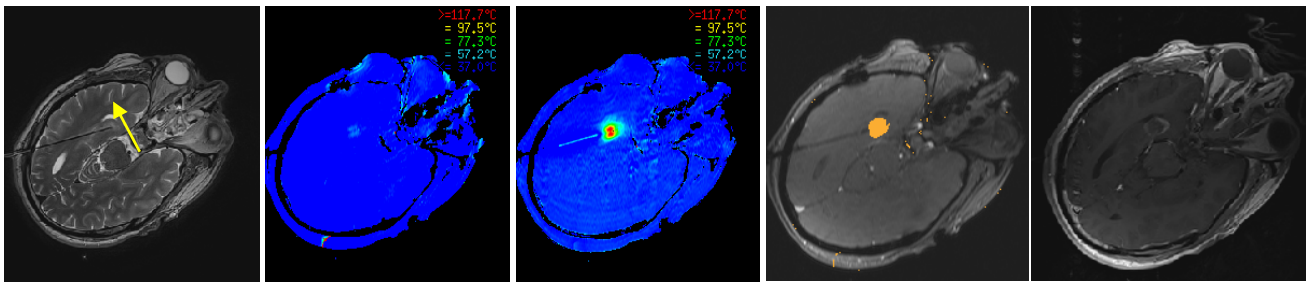
Brain Tumor Thermal Laser Ablation

Principal Investigator: Ferenc Jolesz, M.D.
Co-Investigators: Alexandra Golby, M.D.; Srinivasan Mukundan, M.D., Ph.D.; Emam Saleh, M.D.
Program Launch Date: May 2012
FY12 Volume: 4

Procedure Description:

Interstitial laser is a minimally invasive procedure which can be used to reach lesions deep in the brain that are otherwise difficult to access by conventional surgical methods. During the procedure, a cooling catheter is precisely inserted into the brain via a stereotactic approach.

Placement is confirmed with MR imaging and a laser fiber is passed through the catheter. Temperature mapping using MR imaging is continuously acquired, and test heating is performed at a low level to confirm the location of the laser relative to the target. The ablation is then performed and monitored with MR imaging and the treatment area is visualized with software. Treatment itself takes only a couple of minutes.



Rationale for Using AMIGO:

Ability to perform both the catheter placement and the ablation itself without moving the patient.

Key Findings /Lessons Learned:

Refining methods of targeting. Refining software for temperature mapping.

Neurosurgery

Craniotomy for Brain Tumor

Principal Investigator: Alexandra Golby M.D.
Co-Investigators: Ennino Chiocca, M.D.; Elizabeth Claus M.D.; Ian Dunn, M.D.; Srinivasan Mukundan, M.D., Ph.D.
Program Launch Date: August 2011
FY12 Volume: 22

Procedure Description:

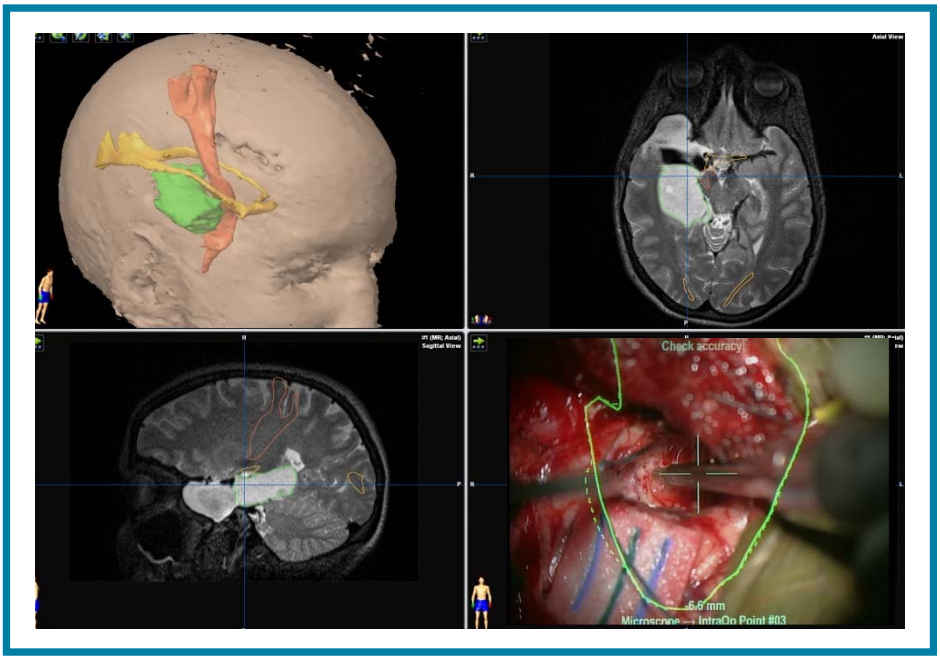
- Intraoperative MRI is utilized to improve tumor resection.
- Functional imaging and diffusion tensor imaging is utilized to map the brain.

Rationale for Using AMIGO:

Improved tumor resection leads to better outcomes - Longer survival and fewer deficits.

Key Findings /Lessons Learned:

- Coregistering US and MRI to guide surgical resection.
- Improving intraoperative imaging especially DTI has been challenging.



Neurosurgery

AMIGO guided Transnasal Endoscopic Removal of Pituitary Macroadenomas

Principal Investigator: Edward Laws, M.D.
Co-Investigators: Ian Dunn, M.D.; Srinivasan Mukundan, M.D., Ph.D.
Program Launch Date: November 2011
FY12 Volume: 12

Procedure Description:

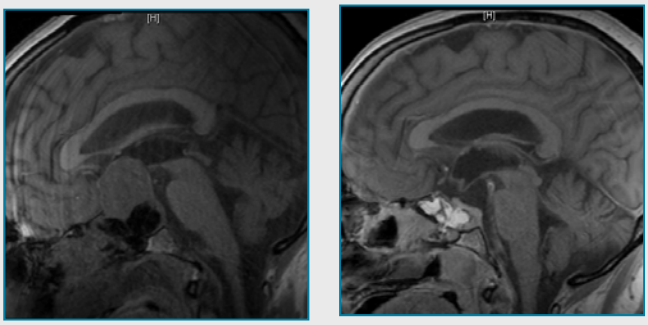
MRI guided transnasal endoscopic resection of pituitary macroadenomas.

Rationale for Using AMIGO:

Improved completeness of tumor removal confirmed and normal functioning pituitary gland preserved.

Key Findings /Lessons Learned:

In 25% of cases, there were instances of tumor remnants that would not have been detected or removed without the aid of AMIGO! None of these operated patients had a new pituitary deficit postoperatively.



Post resection #1 Post resection final

- Patient with visual loss and large adenoma compressing optic chiasm
- Trans nasal endoscopic removal of tumor in AMIGO
- AMIGO MRI imaging showed incomplete removal of tumor – persistent optic compression
- Operation resumed and total tumor removal accomplished – complete visual recovery

Breast Surgical Oncology

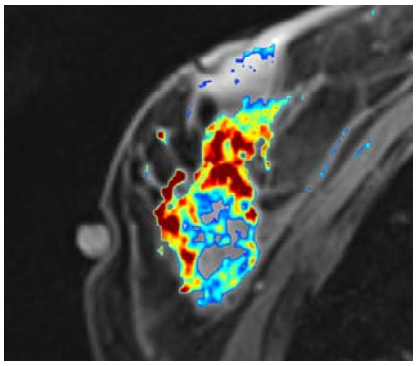
Breast Conserving Therapy and AMIGO

Principal Investigator: Mehra Golshan, M.D.
Co-Investigators: Eva Gombos, M.D.
Program Launch Date: April 2012
FY12 Volume: 3

Procedure Description

In the United States women who undergo breast conserving therapy (lumpectomy followed by radiation) will have to return for a second operation to achieve clear margins nearly 40% of the time. The surgical procedure performed in AMIGO enables intraoperative margin evaluation using breast MRI before and after the lumpectomy.

Rationale for Using AMIGO:



The ability of intraoperative MRI performed prior to and after lumpectomy enables the surgeon to evaluate the tumor edges in real time and determine if additional tissue to be removed. Breast MRI is the most sensitive and specific modality for evaluating a breast tumor. Breast tissue can not be tested intraoperatively by routine pathology evaluation, and other modalities must be developed to reduce the need for reoperation which leads to delay in initiation of chemotherapy or radiation, increased infection rate, increased cost and a negative psychological impact on the patient.

Key Findings /Lessons Learned:

- AMIGO identified additional abnormalities which were excised intraoperatively and all cases achieved clear margins.
- All patients who underwent whole breast radiation have had no evidence of recurrence, to date.
- All patients were excited and motivated to be part of the study.

Radiology

Prostate Biopsy

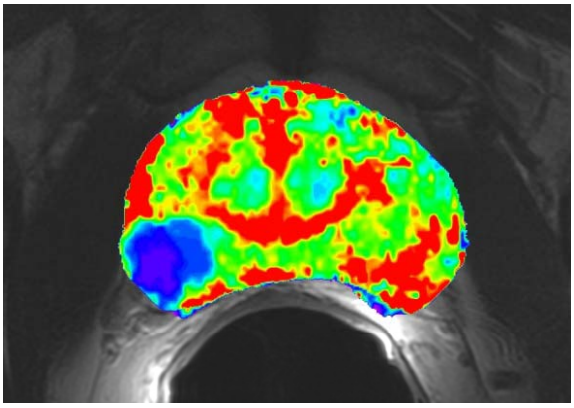
Principal Investigator: Clare Tempany, M.D.
Co-Investigators: Kemal Tuncali, M.D.
Program Launch Date: September 2011
FY12 Volume: 29

Procedure Description:

MR guided prostate biopsies are performed at an increasing rate as they allow for precise targeted sampling of focal lesions identified on pre-biopsy MRI – the latter examination has demonstrated marked improved discrimination abilities for detection of focal lesions.

Rationale for Using AMIGO:

AMIGO is being used to design and evaluate an optimal MRI-guided prostate biopsy system by using two new MR guided prostate biopsy methods, namely free-hand and robotic guided methods in a 3T magnet.



We have developed technology to implement multi-modal image registration of prostate MRI and pre-computed statistical atlases of likely cancer sites. Additionally, we will evaluate the clinical results of the biopsy methods and compare to both our current MR guided technique and the TRUS sextant method.

Key Findings /Lessons Learned:

Pre-Biopsy MRI is highly accurate for defining focal prostate cancer. Transperineal in bore biopsy is highly acceptable, safer than TRUS and desirable to patients.

Radiology

3T MRI Guided Percutaneous Tumor Ablation

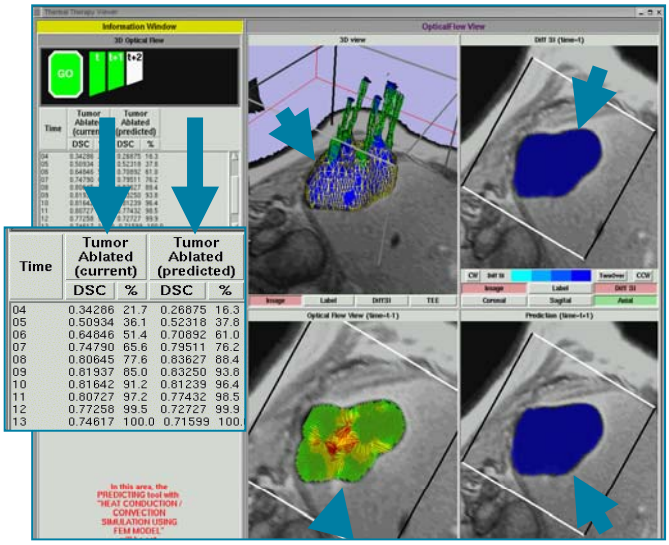
Principal Investigator: Kemal Tuncali, M.D.
Co-Investigators: Paul Shyn, M.D.; Servet Tatli, M.D.
Program Launch Date: November 2011
FY12 Volume: 54

Procedure Description:

Patients with abdominal/pelvic, soft-tissue or bone tumor who need a minimally invasive treatment options are treated with 3T MRI-guided cryoablation.

Rationale for Using AMIGO:

These typically are tumors best visualized with MRI and/or with near-by critical structures where careful monitoring of the ablation is needed. Safety, clinical impact, and treatment efficacy by patient follow-up will be analyzed. Intraprocedural cryoablation monitoring images will be retrospectively utilized for the development and validation of a computerized monitoring tool under an NIH grant.



Real-time Monitoring and Controlling of Ablation

Key Findings /Lessons Learned:

Real-Time MR Thermometry offers highest accuracy available to ensure complete tumor coverage and ablation. Image guidance and control is critical in key anatomical areas to ensure safety.

Radiology

3T MRI Guided Soft Tissue Biopsy

Principal Investigator: Kemal Tuncali, M.D.
Co-Investigators: Paul Shyn, M.D.; Servet Tatli, M.D.
Program Launch Date: September 2011
FY12 Volume: 9

Procedure Description:

Patients with chest, abdominal or pelvis mass best visualized with MRI that require tissue diagnosis benefit from MRI-guided biopsy. The procedure is either part of an ablation procedure to obtain tissue just before the ablation, or in some cases a stand-alone procedure for the purpose of tissue diagnosis.

Rationale for Using AMIGO:

Using 3T MRI guidance, masses are more readily visualized and biopsied. Biopsy yield, needle placement accuracy, safety, clinical impact will be analyzed by patient follow-up in a retrospective fashion.

Key Findings /Lessons Learned:

MR has improved ability to define targets and guide needle course

Radiology

PET/CT Guided Percutaneous Biopsy and Tumor Ablations

Principal Investigator: Servet Tatli, M.D.
Co-Investigators: Victor Gerbaudo, Ph.D., MSHCA; Paul Shyn, M.D.; Clare Tempany, M.D. ; Kemal Tuncali, M.D.
Program Launch Date: May 2012
FY12 Volume: 5

Procedure Description:

Patients with thoraco-abdominal-pelvic, soft-tissue or bone tumors who need hystopathological diagnosis are biopsied under PET/CT guidance.

Rationale for Using AMIGO:

PET/CT combines both anatomical and metabolic information and can help select metabolically active tissue or metabolically active portions of a mass to biopsy. In addition, PET/CT can allow targeting of metabolically active lesions that are not visualized on anatomical imaging modalities such as CT, MRI, and US.

Key Findings /Lessons Learned:

The fusion of contrast-enhanced CT with FDG PET on immediate post-ablation PET/CT scans is a superior method for confirming complete ablation coverage of the tumor. The reason PET/CT is so good at this, is that tumor remains FDG avid immediately after ablation, and therefore remains well-visualized on PET. The ablation volume is well-depicted on contrast-enhanced CT. Using a suspended respiration technique, we are able to better assess our results than with contrast-enhanced CT alone.

Radiation Oncology

Gynecologic Radiation Using Brachytherapy for Women with Cervical, Uterine and Vulvar Cancer

Principal Investigator: Akila Viswanathan, M.D., MPH
Program Launch Date: September 2011
FY12 Volume: 28

Procedure Description:

Women with gynecologic malignancies undergo brachytherapy as part of curative management. In AMIGO, triple-image guided insertion of brachytherapy needles directly into the center of the cancer is feasible. Ultrasound is used to guide applicator insertion. MRI allows contouring the tumor and visualizing the rectum and bladder. CT is used for identifying the applicator in radiation treatment planning.

Rationale for Using AMIGO:

The availability of all three (US, MRI, CT) imaging modalities in one location has provided the ideal environment for patient care and research. Patients that would be considered incurable are now able to undergo curative brachytherapy.

Key Findings /Lessons Learned:

100th Case Performed!

We are analyzing patient outcomes and preliminary data indicate clinical improvements with the use of AMIGO-based image guidance for radiation. Novel developments in image acquisition and radiation planning have received grant funding and, in addition to clinical assessments, are active areas of scientific research.

Radiation Oncology

MRI-Guided Prostate Brachytherapy

Principal Investigator: Paul Nguyen, M.D.
Program Launch Date: February 2012
FY12 Volume: 3

Procedure Description:

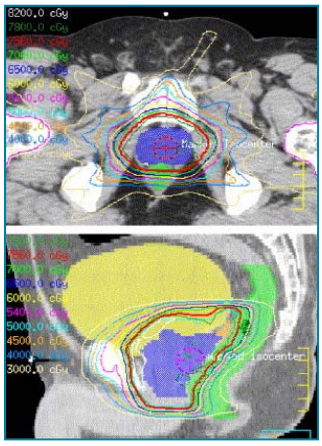
We are performing prostate brachytherapy under direct MRI guidance without the use of an ultrasound probe.

Rationale for Using AMIGO:

Using AMIGO allows us to treat patients who cannot have a trans-rectal ultrasound probe, such as patients with prior rectal cancer surgeries. Also, the MRI visualization allows us to perform focal brachytherapy on only the diseased part of the gland, thereby reducing side effects.

Key Findings /Lessons Learned:

- First case of whole-gland treatment with pure MRI-only guidance on January 17, 2013.
- Three cases have been performed in AMIGO using ultrasound with immediate post-op MRI for visualization of novel spacer material injected between prostate and rectum.
- Protocol being developed for purely focal brachytherapy.



Cardiology

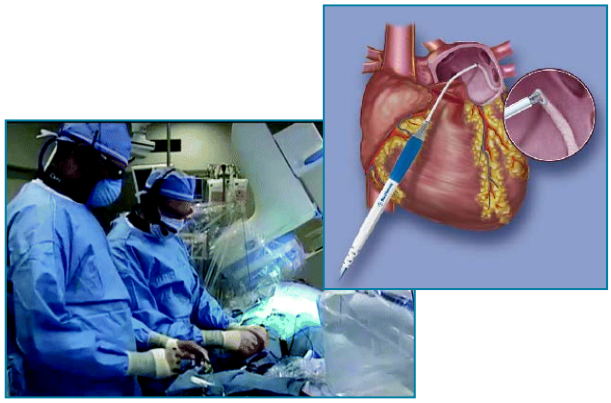
XMR Guided Cardiac Ablation

Principal Investigator: Lawrence Epstein, M.D.; Gregory Michaud, M.D.
John Roy, M.D., Ph.D.

Program Launch Date: December 2011

FY12 Volume: 7

Procedure Description:



Atrial fibrillation (AF) is a rapid irregular heart rhythm originating in the upper chambers of the heart called the atria. AF can be treated with catheter ablation. This ablation procedure is called Pulmonary Vein Isolation (PVI). In catheter ablation, catheters (thin, flexible, plastic tubes or wires) are inserted into blood vessels. These catheters can be placed inside the heart to ablate (damage) parts of the heart tissue that cause AF. The areas of the heart most commonly responsible for atrial fibrillation are the pulmonary veins. By damaging the tissue around the pulmonary veins the abnormal signals are blocked from spreading to the rest of the heart. This is called isolating the pulmonary veins.

Rationale for Using AMIGO:

Test ability to perform MRI-scanning on patients after PVI with paroxysmal AF in order to establish safety of performing PVI in the AMIGO suite and feasibility of obtaining high-quality DE-MR scans.

Key Findings /Lessons Learned:

High quality imaging of acute and chronic ablation lesions in the left atrium is feasible. Such imaging may allow identification and treatment of potential conduction gaps that could decrease the risk of recurrent AF following an initially successful procedure, which is the focus of the next phase of study.

Phase II Program Pipeline

Up and Coming Programs

Department of Surgery

Surgical Service: General and GI Surgery

Procedure Name: Parathyroid Resection

Proceduralist(s): Daniel Ruan, M.D.

Surgical Service: Thoracic Surgery

Procedure Name: Image Registered Endoscopy - Thorax

Proceduralist(s): Raphael Bueno, M.D.

Surgical Service: Surgical Oncology

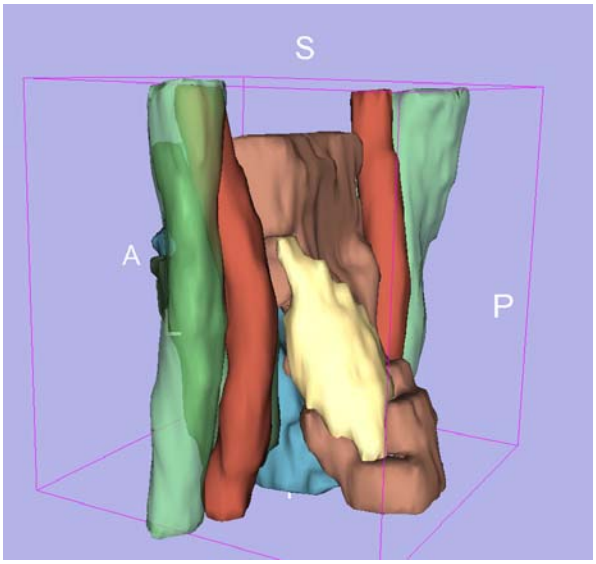
Procedure Name: Peripheral Sarcoma

Proceduralist(s): Chandrajit Raut, M.D.

Surgical Service: General and GI Surgery

Procedure Name: Image Guided Abdominal Surgery

Proceduralist(s): Ali Tavakkoli, M.D.



Up and Coming Programs

Department of Neurosurgery

Procedure Name: Intraoperative Multimodality imaging for Skull Base Surgery

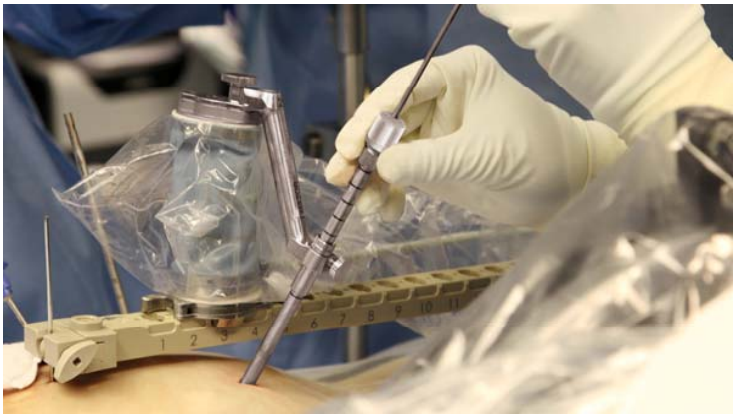
Proceduralist(s): Ian Dunn, M.D. (PI); Ossama Al-Mefty, M.D.; Edward Laws, M.D.

Procedure Name: Intraoperative Image-Guided Brachytherapy for Locally Recurrent Brain Tumors

Proceduralist(s): Nils Arvold M.D.; Alexandra Golby M.D.; Phillip Devlin M.D.

Procedure Name: Real-time Image-guided functional Neurosurgery

Proceduralist(s): Travis Tierney, M.D., Alexandra Golby, M.D.



Department of Medicine – GI Medicine

Procedure Name: Image Registered Endoscopy - Pancreas

Proceduralist(s): Christopher Thompson, M.D.

Up and Coming Programs

Department of Radiology

Procedure Name: PET/CT and US-Guided Liver or Lung Tumor Ablation Using FDG PET and Ammonia Perfusion PET

Proceduralist(s): Paul Shyn, M.D. (PI); Servet Tatli, M.D.; Kemal Tuncali, M.D.

Procedure Name: US and CT-Guided Microwave Ablation of Liver Adenomas

Proceduralist(s): Paul Shyn, M.D. (PI); Servet Tatli, M.D.; Kemal Tuncali, M.D.

Procedure Name: MRI-Guided Cryoablation of Head, Neck and Spine Nerves and Facets

Proceduralist(s): Thomas C. Lee, M.D. (PI); Deepak Raghavan, M.D.

Procedure Name: MRI-Guided Biopsies and Ablation of Head, Neck and Spine Tumors

Proceduralist(s): Thomas C. Lee, M.D. (PI); Deepak Raghavan, M.D.

Procedure Name: PET/CT-Guided Biopsies and Ablations of Head, Neck and Spine Tumors

Proceduralist(s): Thomas C. Lee, M.D. (PI); Deepak Raghavan, M.D.

In the News

In the News

BWH Publications

BWH Bulletin

Nov. 2012: Research into Breast Cancer Procedure Could Prevent Repeat Surgeries

http://www.brighamandwomens.org/about_bwh/publicaffairs/news/publications/DisplayBulletin.aspx?articleid=5759

Nov. 2011: True AMIGOS

http://www.brighamandwomens.org/about_bwh/publicaffairs/news/publications/displaybulletin.aspx?articleid=5391

May 2011: BWH Unveils New AMIGO Suite

http://www.brighamandwomens.org/about_bwh/publicaffairs/news/publications/DisplayBulletin.aspx?articleid=5232

BWH Clinical & Research News

June 2012: AMIGO Update: Neurosurgery Procedures and More

http://www.brighamandwomens.org/about_bwh/publicaffairs/news/publications/DisplayCRN.aspx?articleid=2003

In the News

External Media

Ch 4 – WBZ TV
New Operating Room At BWH Helps Breast Cancer Patients Avoid Multiple Surgeries
http://boston.cbslocal.com/2012/12/07/new-operating-room-at-bwh-helps-breast-cancer-patients-avoid-multiple-surgeries/

Huffington Post
Positive Margins, Positively Unacceptable
http://www.huffingtonpost.com/susan-scanlan/positive-margins-breast-cancer_b_2696955.html

Boston Globe
A higher vision for the O.R.
http://www.bostonglobe.com/business/2012/05/19/higher-vision-for/8ZPQZTs2Mp9ONo8sR6QsKN/story.html

New operating room a high-tech wonder
http://www.bostonglobe.com/business/2011/12/26/new-operating-room-high-tech-wonder/qIcq0F25Mkb3xm5B5VCueJ/story.html

BWH press release: Jan. 9, 2013
New Tool to Help Brain Surgeons, One Step Closer to Operating Room
http://www.brighamandwomens.org/about_bwh/publicaffairs/news/pressreleases/PressRelease.aspx?PageId=1356

ScienceBlog.com
New tool to help brain surgeons one step closer to operating room
http://scienceblog.com/59524/new-tool-to-help-brain-surgeons-one-step-closer-to-operating-room/

Further Reading

AMIGO Publications

1. Agar NY, Golby AJ, Ligon KL, Norton I, Mohan V, Wiseman JM, Tannenbaum A, Jolesz FA. Development of sterotactic mass spectrometry for brain tumor surgery. Neurosurgery. 2011 Feb; 68(2): 280-289; discussion 290.

2. Colen RR, Kekhia H, Jolesz FA. Multimoldaity and intraoperative MRI for brain tumor surgery. Exerpt Rev Neurother. 2010 Oct; 10(10): 1545-1558.

3. Fedorov A, Tuncali K, Fennessy FM, Tokuda J, Hata N, Wells WM, Kikinis R, Tempany CM. Image registration for targeted MRI-guided transperineal prostate biopsy. J Magn Reson Imaging. 2012 Oct; 36 (4) :987-92. PubMed PMID:22645031; PubMed Central PMCID: PMC3434292.

4. Fennessy FM, Fedorov A, Gupta SN, Schmidt EJ, Tempany CM, Mulkern RV. Practical considerations in T1 mapping of prostate for dynamic contrast enhancement pharmacokinetic analyses. Magn Reson Imaging. 2012 Nov; 30 (9) :1224-33. PubMed PMID:22898681; PubMed Central PMCID: PMC3466364.

5. Hegde JV, Chen MH, Mulkern RV, Fennessy FM, D'Amico AV, Tempany CM. Preoperative 3-tesla multiparametric endorectal magnetic resonance imaging findings and the odds of upgrading and upstaging at radical prostatectomy in men with clinically localized prostate cancer. Int J Radiat Oncol Biol Phys. 2012 Oct 2; PubMed PMID:23040223.

6. Jolesz FA. Intraoperative imaging in neruosurgery: where will the future take us? Acta Neurochir Suppl. 2011; 109: 21-25. doi: 10.1007/978-3-211-99651-5_4.

7. Orringer DA, Golby AJ, Jolesz FA. Neuronavigation in the surgical management of brain tumors: current and future trends. Expert Rev Med Devices. 2012 Sep; 9(5): 491-500. doi: 10.1586/erd.12.42.

8. Panych LP, Roebuck JR, Chen NK, Tang Y, Madore B, Tempany CM, Mulkern RV. Investigation of PSF-choice method for reduced lipid contamination in prostate MR spectroscopic imaging . Magn Reson. Med (epub ahead of print 2012).

9. Pursley J, Risholm P, Fedorov A, Tuncali K, Fennessy FM, Wells WM, Tempany CM, Cormack RA. A Bayesian nonrigid registration method to enhance intraoperative target definition in image-guided prostate procedures through uncertainty characterization. Med Phys. 2012 Nov; 39 (11) :6858-67. PubMed PMID:23127078.

10. Tokuda J, Song SE, Fischer GS, Iordachita II, Seifabadi R, Cho NB, Tuncali K, Fichtinger G, Tempany CM, Hata N. Preclinical evaluation of an MRI-compatible pneumatic robot for angulated needle placement in transperineal prostate interventions. Int J Comput Assist Radiol Surg. 2012 Nov; 7 (6) :949-57. PubMed PMID:22678723.

Abstracts / Proceedings

1. Fedorov A, Ibanez L, Tuncali K, Mulkern RV, Wells WM, Tempany CM, Fennessy FM. Deformable Registration for Recovering Image Distortions in DWI MRI of the Prostate at 3T Traditional poster. May 9th 10:00-12:00am. Program number 1503. Session; Prostate.

2. Fennessy FM, Fedorov A, Gupta SN, Wells WM, Mulkern RV, Tempany CM. Assessment of abnormal ADC matched voxels with DCE parameters for characterization of prostate cancer at 3T. Oral presentation.May 10th 11:18am. Session;Prostate Cancer, Room:210-211.

3. Gupta SN, .Schmidt EJ, Mulkern RV, Fedorov A, Hancu I, Zhu Y, Tempany CM, Fennessy FM. A Method for Correcting T1 maps of Prostate at 3T Obtained by Variable Flip Angle Imaging. Traditional poster. May 9th 13:30. Session; Prostate.Program # 1962

4. Moradi M, Fedorov A, Wells WM, Tuncali K, Gupta SN, Fennessy FM, Tempany CM. Machine learning for target selection in MR-guided prostate biopsy: A preliminary study (Traditional poster) Session: Prostate Day/Date: 9 May 2012

5. Tuncali K, Fedorov A, Fennessy FM, Gupta SN, Tokuda J, Song S, Hata N, Mulkern RV, Tempany CM. Predictive Value of 3T mpMRI: Correlation with MRI-guided Transperineal Targeted Prostate Biopsy Outcomes E-poster. Session: Prostate & Breast. Day/Date: 7 May 2012.

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