James H Thrall MD
Radiologist-in-Chief
Massachusetts General Hospital
Juan M Taveras Professor of Radiology
Harvard Medical School
Who We Are

- 1900 department members
  - 115 MD clinical faculty
  - 95 clinical fellows and residents
  - 155 non clinical MD/PhD faculty
  - 100+ research fellows and post docs
  - ~ 1500 clinical and research support staff
Patient Care

- 900,000 annual examinations and procedures
- 11 subspecialty divisions
- 15 locations
Mass General Imaging: “The Big Picture”
Departmental leaders—Vice Chairmen

- Daniel I Rosenthal MD—Senior Vice Chairman for Operations
- Theresa McLoud MD—Education
- Thomas J Brady MD—Research
- Giles Boland MD—Business Development
- Keith Dreyer DO PhD—Informatics
- Sanjay Saini MD—Finance
- Scott Gazelle MD PhD—Faculty Development
Departmental leaders

- Robert Novelline MD—Director, Harvard Radiology Clerkship
- Gloria Salazar MD—Director of Quality and Safety
- Dushant Sahani MD—Medical Director, Computed Tomography
- Pamela Schaefer MD—Medical Director, MRI
- Javier Romero MD—Medical Director, Ultrasound
- Anthony Samir MD—Associate Medical Director, Ultrasound
- Gordon Harris PhD—Director, 3D Laboratory
- Sanjeeva Kalva MD, Director, Center for Image Guided Cancer Therapy
Division Heads

Elizabeth A. Rafferty, MD
Director
Breast Imaging

Peter R. Mueller, MD
Director
Abdominal Imaging & Intervention

Thomas J. Brady, MD
Director
Nuclear Medicine & Molecular Imaging and Director Cardiovascular Imaging & Intervention

Robert A. Novelline, MD
Director
Emergency Imaging

William E. Palmer, MD
Director
Musculoskeletal Imaging & Intervention

James H. Thrall, MD
Radiologist-in-Chief

Joshua A. Hirsch, MD
Director
Interventional Neuroradiology & Endovascular Neurosurgery

Stephan Wicky, MD
Director
Vascular Interventional Imaging

R. Gilberto Gonzalez, MD, PhD
Director
Neuro Imaging

Debra A. Gervais, MD
Director
Pediatric Imaging

Jo-Anne O. Shepard, MD
Director
Thoracic Imaging
Leadership Group

Jae W Lee – Executive Director

Directors: MT Shore, George Desko, Kevin Conway, Alison Wright, Karen Lemaire, Kevin Pian, Rob Sheridan
Leaders of Research Programs

• Thomas Brady MD– Nuclear Medicine
• Bruce Rosen MD PhD-- Martinos Center
• Ralph Weissleder MD PhD– Center for Molecular Imaging Research, Center for Systems Biology
• Steve Dawson MD– Sim Group
• Eng Lo PhD– Neuroprotection Laboratory
• Scott Gazelle MD PhD– MGH Institute for Technology Assessment
Leaders of Research Programs

• Michael Moskowitz MD—Neuroscience
• G Ramon Gonzalez PhD MD—Neuroradiology
• Martin Torriani MD—Musculoskeletal Research Core
• Homer Pien PhD—Laboratory for Medical Imaging and Computations
• Udo Hoffman MD—Cardiac MR PET CT Program
• James Thrall MD, Dushant Sahani MD, Manudeep Kalra MD—Webster Center
<table>
<thead>
<tr>
<th>Institution</th>
<th>Funding ($)</th>
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<tr>
<td>Massachusetts General Hospital</td>
<td>71,068,986</td>
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<td>Univ Of California San Fran</td>
<td>53,100,485</td>
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<td>Brigham and Women's Hospital</td>
<td>33,253,128</td>
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<td>Stanford University Sch Of Medicine</td>
<td>32,342,009</td>
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<td>Johns Hopkins University Sch Of Medicine</td>
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<td>Univ Of Pennsylvania Sch Of Medicine</td>
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<td>Washington University Sch Of Medicine</td>
<td>16,424,104</td>
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<td>University Of Minnesota Medical School</td>
<td>15,628,276</td>
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<td>Memorial Sloan Kettering Cancer Center</td>
<td>15,530,520</td>
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<td>Vanderbilt University Sch Of Medicine</td>
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- Over 400 total grants from all sources
- Over 190 individuals serving as principle investigators (PIs)
MGH Imaging Milestones

- One of the first x-ray exams performed in the US-- First in a Boston hospital
- Invention of Positron Coincidence Scanning (PET) 1953
- First patient in the world imaged with combined PET/MRI device-- 2008
- First hospital based CT in US
- First hospital based MRI in the US
- First practical synthesis of FDG
First in history positron images  (1953)
Recurrent brain tumor
Brownell and Sweet-- MGH

Courtesy of Anna-Lisa Brownell
First in history simultaneous MR-PET scan in a patient-2008
54 year old with malignant glioma and cutaneous extension

PET
- 5.45 mCi FDG injected approx. 2.5 hours prior to data acquisition
- OSEM 3D reconstruction
- Attenuation correction performed based on the MR data

MR
- T1 MP-RAGE, T2 SPACE (shown), FLAIR, DTI, CSI, SVS sequences run simultaneously
- CP coil

NCRR/Catana/Benner/van der Kouwe/Andronesi/Jennings/Gerstner/Plotkin/Rosen/Sorensen (MGH)
MGH MR Milestones

- First report of MRI angiography
- MRI “Susceptibility”
- First report of fMRI 1991
- BOLD-- blood oxygen level dependent imaging (with others)
- Perfusion and diffusion imaging
- DTI and DSI Tractography invented-- applications in heart and brain
- Brain mapping-- brain “inflation”
- Pharmacologic MRI-- phMRI
Functional MRI

Photic Stimulation

From Belliveau, et al.
Science Nov 1991

MGH-NMR Center
DSI in vivo human

human connectome

Re-emergence of White Matter Tracts

Supported by US PHS Grant R21-CA117079
MGH Molecular Imaging Milestones

- First dedicated “Molecular Imaging” program 1994
- MION: Monocrystalline iron oxide nanoparticles
- CLIO Cross linked iron oxide nanoparticles
- Near infrared fluorescence imaging (NIRF) smart probes
- NIRF tomography
- MRI cell detection system- DMR -- “lab on a chip”
LN mets from prostate cancer

Benign

Malignant
Prostate cancer micrometastases
MGH Imaging Milestones

• First application of radiofrequency for ablation of osteoid osteoma
• Extension of RFA to other tumors
• Invention of breast tomosynthesis
• First clinical breast tomosynthesis patient exam in the United States --2011
MGH Transformations in Clinical Care

- CT guided drainage of abdominal abscess
- Diagnostic criteria for assessing adrenal masses
- Image guided lung biopsy
- Diagnostic criteria for diffuse lung disease
- CT for suspected appendicitis and the non-traumatic acute abdomen
- Perfusion/diffusion MRI in stroke—core and penumbra
- Many, many others…
Stroke: MR Diffusion / Perfusion Imaging Mismatch Marker for Territory at Risk

T2 FSE  Initial DWI  Initial MTT  F/U DWI (5 D)
H2O Motion  Blood Flow

AGS / MGH
MGH Imaging Milestones: IT

- Early RIS and RTAS developed at MGH-- mid 1970s
- Early PACS --RSTAR-- late 1980s, Agfa 1996
- Voice recognition--adopted 1995
- MGH Radiology Order Entry System--ROE
- ROE with decision support-- ROE DS
- RENDER image search program
- QPID-- ontology and semantic based search of the medical record
- SamePage-- administrative dashboard
- Qatch All-- quality and safety reporting system
- Grapevine-- consensus based peer review system
- Cloud computing for managing outside cases
CPOE Login Screen

For assistance try Help, or contact:

Bill Barron
1-617-643-2198
Page 1-617-724-5700 p/n# 22172

Michelle Dern
1-617-643-2404
Page 1-617-724-5700 p/n# 22082

Upload outside images via ROE

ROE now offers a self-service system that allows Mass General physicians to upload radiology studies from non-MGH healthcare providers to PACS and LMIR/Oncall.

>> Click here for details <<
Alerts Delivered Automatically

Head (Brain) MRI

MRA CAUTIONS (more)

<table>
<thead>
<tr>
<th>If the Patient Has</th>
<th>Please Do The Following</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacemaker, AICD or Pacing Wires</td>
<td>MRI Contraindicated. Do not Schedule. Refer to radiologist for alternative imaging options.</td>
</tr>
<tr>
<td>Implants (any type) i.e., Ear, Cerebral aneurysm clips, Heart Valve, Stent, Stimulator, Pump</td>
<td>Patient must bring device specifics to the exam i.e. Manufacture, model number and serial number</td>
</tr>
<tr>
<td>Claustrophobia</td>
<td>Consider Pre-Medication</td>
</tr>
<tr>
<td>Metallic foreign body (eye)</td>
<td>Obtain XRAY of Orbit prior to MRI</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>Consider rescheduling, contrast must not be used</td>
</tr>
<tr>
<td>Obesity</td>
<td>CT, MRI, and X-ray have table weight limits that cannot be exceeded (more)</td>
</tr>
</tbody>
</table>

For pediatric sedation call 1-617-724-4207

EXAM REQUESTED Pick only ONE of the Following
To order a MRA exam please select it from MR drop down menu.

- Head MRI
- Head MRI w MRS
- Head MRI w Tumor Volume and MRS

- Head MRI with 3D
- Head MRI w Tumor Volume
When is Imaging Helpful for Patients with Back Pain?

Imaging Modalities for the Spine

Scheduling

Further Information

References

Since the lifetime prevalence of low back pain is about eighty percent, it is hardly surprising that back pain is one of the most common reasons for patients to seek medical care. However, in the vast majority of cases, acute back pain (duration less than three months) is a self-limited condition that resolves with analgesic treatment and activity modification. In more than 80% of cases of back pain (Table 1), imaging will not affect treatment. However, it may lead to unnecessary additional testing due to the discovery of incidental benign lesions and nonspecific degenerative processes that may also occur in asymptomatic individuals.

In a recent study of patients with low back pain who had been referred for radiographic evaluation, only 3.7% went on to have surgery. However, the rate of

**Figures A and B:** In a 72 year old patient with intermittent low back pain, MR images of the lumber spine show multi-level abnormalities, such as severe spinal stenosis at L3-4 and disk herniation at L5-S1, that are far more impressive than the degree of symptoms.
Duplicate Exam Warning

Search engine finds all prior or scheduled exams of the same type.
Recurrent increasingly severe headaches
Images / 100 Patients By Doctor
Measured In 2006 and 2009

2006 practice mean = 16.1
standard error = 0.74

2009 practice mean = 12.1
standard error = 0.54
ROE Exams Scheduled/Rescheduled vs. Phone Calls Answered

2010

Overall increase of approximately 90% since 2006

Overall decrease of approximately 30% since 2006
MGH Webster Center for Advanced Research and Education On Radiation Dose
<table>
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<tr>
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<tbody>
<tr>
<td></td>
<td>Mean Eff Dose (mSv)</td>
<td>Mean Eff Dose (mSv)</td>
<td>Mean Eff Dose (mSv)</td>
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<tr>
<td>Abdomen</td>
<td>10</td>
<td>12</td>
<td>6.9</td>
</tr>
<tr>
<td>Chest</td>
<td>7</td>
<td>7</td>
<td>3.5</td>
</tr>
<tr>
<td>CTA Heart</td>
<td>20</td>
<td></td>
<td>3.3 (median)</td>
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<tr>
<td>Head</td>
<td>2</td>
<td>2</td>
<td>0.7-1.0</td>
</tr>
<tr>
<td>Spine, Cervical</td>
<td>10</td>
<td>5</td>
<td>3.4</td>
</tr>
<tr>
<td>CTC</td>
<td>10</td>
<td>8</td>
<td>5.9</td>
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Chairman Jim’s Keys to Excellence
And leadership

• Honor the past in the present
• Bring the future into the present
• Envision the future of the future
Honoring the Past in the Present

• Remain steadfast in the commitment to things that should never change
  – Philosophy that each patient’s best interests must come first
  – Quality and safety of care
  – Quality of external and internal service
  – Quality of work life for all

• These characteristics are pillars of medical excellence
Bringing the Future into the Present

• Change is relentless as the future unveils itself
• Rapidly assimilate beneficial aspects of things that inevitably change like technology, knowledge and care delivery paradigms
• Rapidly adapt to negative aspects of other things that inevitably change like compliance requirements and payment systems
• Organizations and people who can do this faster than others will have substantial advantages and be leaders
Envisioning the Future of the Future

• Look over the horizon to see where things that change are going to be, not where they are now
• Skate to where the puck is going to be, not where it is now
• Organizations and people who can anticipate the future, will lead in shaping the future
Envisioning the Future of the Future for Imaging Technology
Technology development

- Increased cost
  - Increased regulations
  - Clinical trials moved offshore
  - Radiation concerns = number one non financial risk to radiology
  - FDA under the gun
  - R&D moved offshore
  - Increasingly difficult to initiate trials in US versus evidence based medicine

- Decreased cost
  - "Defeatured" devices
  - Simplified devices
  - Single organ devices
  - Handheld US
  - BRIC countries
  - SE Asia
  - Africa
  - Extremity CT
  - Head CT
  - Extremity MRI
  - Breast PET

- Hybrid imaging systems
  - PET/CT
  - PET/MRI
  - US/Angio
  - CT
  - MRI

- Simplified devices
  - Single organ devices
  - "Defeatured" devices

- Information Technology
  - Iterative reconstruction
  - Lower doses
  - Massive computing
  - Hybrid imaging systems
  - Decreased cost
  - Simplified devices
  - Iterative reconstruction
  - Lower doses
  - Simplified devices

- Emerging markets
  - Market share
  - Market space
  - Number of products "footprint" in the market
  - Percentage share for a product or service

- Competition
  - Market space
  - Number of products "footprint" in the market
MGH Radiology at the Bicentennial
MGH Radiology at the Bicentennial

Ready for the next 200 years!