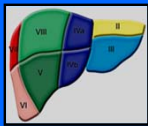
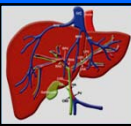
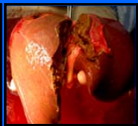


Update on Imaging of Focal Liver Lesions

Name: Dushyant Sahani MD
dsahani@partners.org

MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliate of HARVARD MEDICAL SCHOOL

Update on Focal Liver Lesions

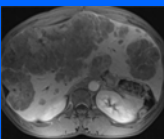
Objectives

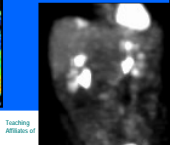
- 1 Discuss common focal liver lesions
- 2 Provide the clinical perspective
- 3 Review the imaging of common benign and malignant lesions
- 4 Learn pitfalls and benefits of advanced imaging methods

MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliate of HARVARD MEDICAL SCHOOL

Evolution of Liver Imaging

“Clinical correlation is required”



MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliate of HARVARD MEDICAL SCHOOL

Focal Liver Lesions

<p>Non-cirrhotic</p> <ul style="list-style-type: none"> ■ Hemangioma ■ FNH ■ Adenoma ■ Biliary Hamartoma ■ Metastases ■ Cholangiocarcinoma ■ Fibro Lamellar HCC ■ Lymphoma 	<p>Cirrhotic</p> <ul style="list-style-type: none"> ■ RGN ■ DSN ■ HCC ■ Cholangiocarcinoma
---	---




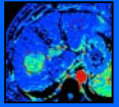
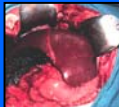

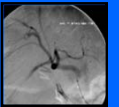
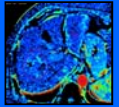
MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliate of HARVARD MEDICAL SCHOOL

Clinical Perspective for Liver Lesions

<ul style="list-style-type: none"> ■ HCC ■ FL-HCC ■ Mets ■ Adenoma ■ FNH ■ Hemangioma 	<p>Resect/Ablate/Chemoembo/OLTx</p> <p>Resect</p> <p>Resect/Chemo/IA therapy</p> <p>Resect/FU</p> <p>Ignore</p> <p>Ignore</p>
---	---

MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliate of HARVARD MEDICAL SCHOOL

Liver Cancer Therapies

Surgery	Ablation	intra-arterial therapy	Systemic chemotherapy
Partial hepatectomy Segmentectomy Transplantation	Radiofrequency Cryoablation Microwave	IA chemo pump IA chemoembo IA microspheres	Conventional chemo Neo-adjvant therapy Radiation therapy
			
			

MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliate of HARVARD MEDICAL SCHOOL

Liver Surgery: Considerations

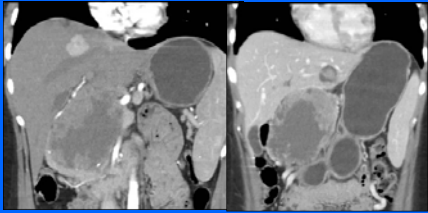
- Poor prognostic factors
 - » Tumor > 7 cm
 - » Multiple lesions
 - » Tumors involving > 2 segments
 - » Requiring major hepatectomy
- Selection for liver Tx
 - » Single tumor < 5 cm
 - » Up to 3 lesions (< 3cm)
 - » Lack of vascular invasion
 - » Absence of extra-hepatic ds.

Lesion Detection and Staging

Homsli J, Garrett CR. Cancer Control 2006;13:42-47
 Cohen AD, Keneny NE. Oncologist 2003;6:553-66
 Marrero JA. Current opinion in Gastroenterology 2006;22:248-253

MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliates of HARVARD MEDICAL SCHOOL

Liver Lesion Characterization

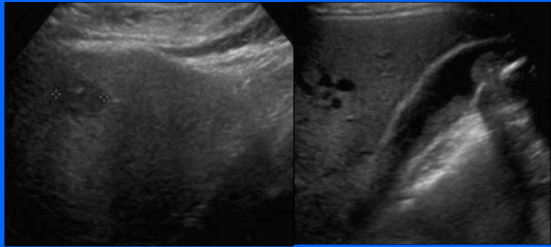


- Pijl et al (Radiology Nov '98)
 - 28 patients undergoing liver tumor surgery
 - 186 lesions: 135 malignant; 51 benign (30 hemangiomas, 19 cysts)

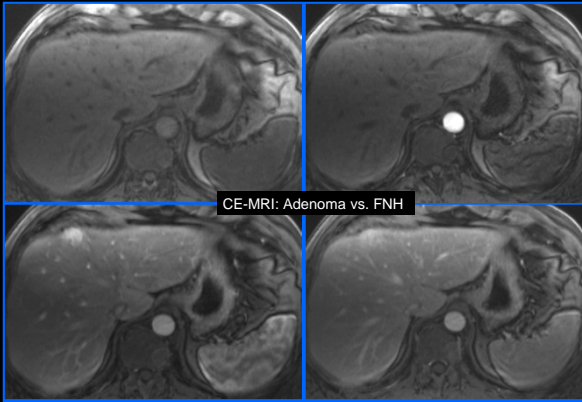
MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliates of HARVARD MEDICAL SCHOOL

Case RS

- 51 yr old women who initially presented with right upper quadrant pain



MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliates of HARVARD MEDICAL SCHOOL



CE-MRI: Adenoma vs. FNH

MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliates of HARVARD MEDICAL SCHOOL

Follow up

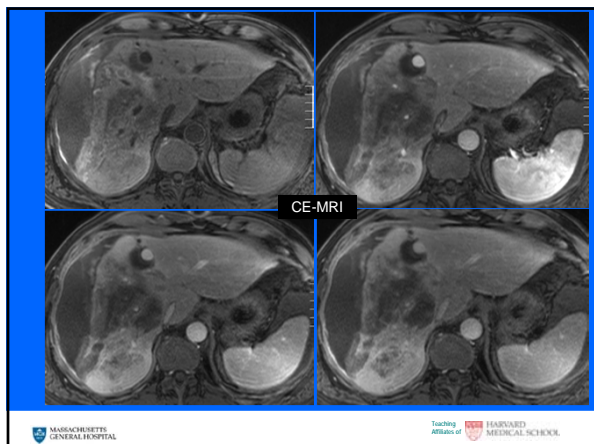
- Undergoes elective lap cholecystectomy and lap wedge resection of liver lesion in segment 4A.
- Post operative course complication by hepatic hematoma, hypotension, shock liver and acute renal failure
- Presented to ER one month after discharge with dyspnea and diaphoresis

MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliates of HARVARD MEDICAL SCHOOL

Result	Value	Reference Range
WBCs	18.6	High
RBCs	3.18	Low
Hemoglobin	8.8	Low
Hematocrit	26.1	Low
Mean corpuscular volume (MCV)	51.6	
Mean corpuscular hemoglobin (MCH)	30.8	
Mean corpuscular hemoglobin conc. (MCHC)	23.8	
Red cell distribution width (RDW-CV)	19.5	High
Platelets	202	
Mean platelet volume (MPV)	7.6	
Neutrophils	82	High
Lymphocytes	6	Low
Monocytes	10	
Eosinophils	3	
Basophils	0	
Neutrophils, absolute	12.7	High
Lymphocytes, absolute	0.9	Low
Monocytes, absolute	1.6	High
Eosinophils, absolute	0.4	
Basophils, absolute	0.0	

Result	Value	Reference Range
Plasma protein	7.0	
Albumin	2.7	Low
Bilirubin	3.28	High
Bilirubin, direct	2.1	High
Alkaline phosphatase	847	High
Aspartate transaminase (AST, SGOT)	182	High
Alanine transaminase (ALT, SGPT)	470	High

MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliates of HARVARD MEDICAL SCHOOL



Hepatic necrosis

- Right hepatic lobe hemorrhagic necrosis secondary to clipping of the right hepatic artery and hypotension from hematoma secondary to pseudoaneurysm.
- Pseudoaneurysm of distal branch of segment 4/middle hepatic artery

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliates of HARVARD MEDICAL SCHOOL

Liver Cancer Therapy Clinical Decision Making

Tumor Burden	Vascular Involvement	Extra-hepatic Disease	Functional Reserve
Number Size Location	Arteries Portal vein Hepatic veins	Distant metastases Lymphadenopathy	Residual volume Cirrhosis Steatosis

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliates of HARVARD MEDICAL SCHOOL

Imaging Choices For Liver Lesions

MDCT 	MR
US 	FDG-PET/PET-CT

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliates of HARVARD MEDICAL SCHOOL

Why use CT for Liver Imaging?


- Assess Lesion/tumor burden
 - Number
 - Size
 - Location
 - Treatment
 - Response
- Evaluate Functional Reserve
 - Future residual volume
 - Steatosis
- Evaluate Vasculature
 - Tumor involvement
 - Variations that may alter surgical resection
- Evaluate for other sites of metastases
 - May preclude surgical resection



MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliates of HARVARD MEDICAL SCHOOL

Benefits of MDCT for Liver Imaging

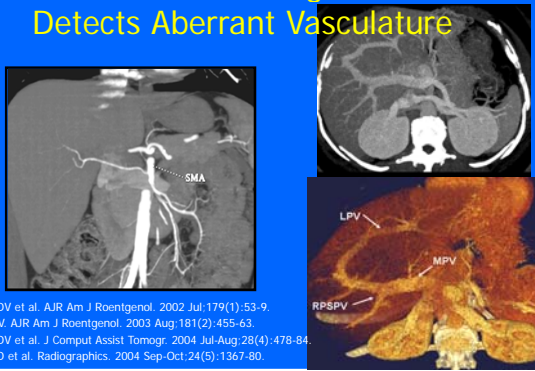
Advantages

- Fast scan (10 sec breathhold)
- Thin section acquisitions
- Retrospective slice recons
 - Multi-phase
 - Excellent quality 3D images






CT Advantages: Detects Aberrant Vasculature





Sahani DV et al. AJR Am J Roentgenol. 2002 Jul;179(1):53-9.
 Kapoor V. AJR Am J Roentgenol. 2003 Aug;181(2):455-63.
 Sahani DV et al. J Comput Assist Tomogr. 2004 Jul-Aug;28(4):478-84.
 Sahani D et al. Radiographics. 2004 Sep-Oct;24(5):1367-80.

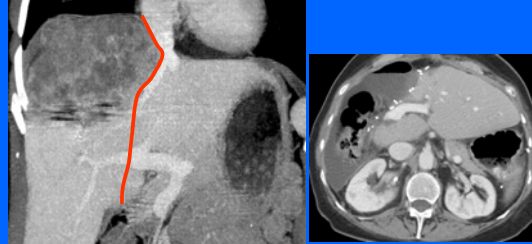
CTA : IA Chemotherapy Pump Placement





Sahani DV. et al. JCAT. 2004. CTA Sn:100%, Sp: 97 %

CT Advantage: Pre-surgical planning



Sahani D et al. Radiographics. 2004 Sep-Oct;24(5):1367-80.
 Catalho OA et al. Radiographics. 2008 Mar-Apr;28(2):359-78.

Monitoring Response to Chemotherapy

Conventional method of monitoring treatment response is change in tumor size

RECIST 1.0

10 Target Lesions (>1-2 cm)
5 max in an organ
Non-target lesions

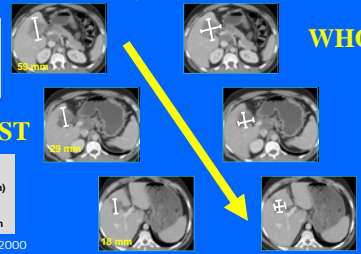
RECIST 1.1



5 Target Lesions (>1 cm)
2 max in an organ
Short-axis of LN>15 mm

Therasse P. et al. JNCI 2000
Therasse P. et al. EJC 2006
Eisenhauer EA et al. EJC 2009

WHO

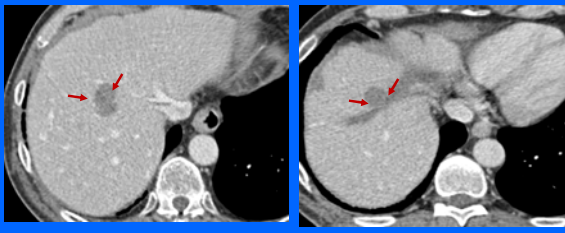
RECIST= Response Evaluation Criteria in Solid Tumors
WHO = World Health Organization








CT Advantages: Treatment Response

■ Radiofrequency Ablation



f/u CT 11 mos

Monitoring Antiangiogenic Response: CT perfusion

Pre- Avastin 10 day Post- Avastin

Favourable Response
Drop in Blood Flow
Drop in Blood Volume

Sahani et al. Radiology 2005/2007, Zhu et al. The Oncologist (2007)

CT Disadvantage: "Lesion Is Too Small To Characterize"

CT Vs. MRI

Lesions > 1.5 cm can be routinely characterized on a MDCT

Small Lesion Detection: CT vs. MR

CT MR

MRI can detect lesions < 1 cm 87-92%

In fatty liver, hypovascular lesions are less conspicuous on CT

MR Advantages

T2 T1 post contrast 20 min delayed

Gd-EOB-DTPA

- Very sensitive for liver lesion detection
- Better lesion detection if hepatic steatosis
-Post- ChemoTx → MRI
- Advanced MR Techniques: Liver-specific (Hepatocyte) contrast agents
- Gd-EOB-DTPA: *Eovist/Primovist*
- Gd-BOPTA: *Multihance*

Small Lesion Detection: CT vs. MR

CT MR

MRI can detect lesions < 1 cm 87-92%

In fatty liver, hypovascular lesions are less conspicuous on CT

CRC Restaging Post Chemotherapy

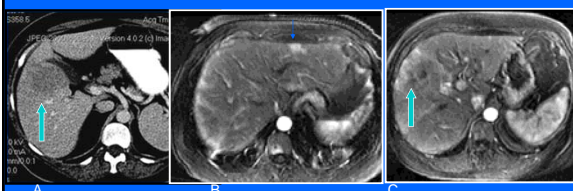
Liver Metastases: CT vs. MR

Studies	CT	MR
> 1cm	<u>91/128 (71%)</u>	<u>115/128 (90%)</u>
< 1 cm	<u>17/47 (38%)</u>	<u>39/47 (83%)</u>

Bartolozzi et al, Radiology 2004


MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliate of HARVARD MEDICAL SCHOOL

Hypervascular Lesion



MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliate of HARVARD MEDICAL SCHOOL

Hemangioma: CECT

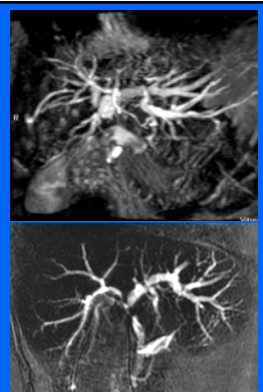


Arterial
Portal
Equilibrium

MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliate of HARVARD MEDICAL SCHOOL

MRI & MRCP

- Evaluate the bile ducts both above and below a stricture
- Also identifying any intrahepatic mass lesions
- Sensitivity 86-100 % for defining stenosis and the level of obstruction.



Adamek HE. 1998 GUT 43:680-683

MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliate of HARVARD MEDICAL SCHOOL

Clinical and MR Considerations

- Demographics and clinical hx
- Enhancement patterns
- Other MR features
 - Signal intensity
 - Margins
 - Central Scar
 - Lipid
 - Hemorrhage
 - Vascular invasion

MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliate of HARVARD MEDICAL SCHOOL

Approach to focal liver lesion

Look for Characteristic Features

Common benign lesions

- Hemangioma
- FNH
- Adenoma

Malignant Lesions

- Heterogeneity
- Wash-out
- Capsule Retraction
- Vascular invasion
- Biliary obstruction

MASSACHUSETTS GENERAL HOSPITAL
Teaching Affiliate of HARVARD MEDICAL SCHOOL

Suspicious Features (non FNH/Hemangioma) or Malignant

Heterogeneity

Wash-out

Hemorrhage

Capsular Retraction

Biliary Obstruction

Vascular Encasement/Invasion

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliates of HARVARD MEDICAL SCHOOL

Hemangioma: MRI

T2WI

Arterial

Portal

Equilibrium

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliates of HARVARD MEDICAL SCHOOL

Hemangioma - MR

- sensitivity
- specificity

> 95%

- ⇌ heavily T2-weighted images
- ⇌ Dynamic CE-MRI

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliates of HARVARD MEDICAL SCHOOL

Hemangioma - Pathology

Capillary

Cavernous

Sclerosing

Sclerosed

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliates of HARVARD MEDICAL SCHOOL

Focal Nodular Hyperplasia: Gd-DTPA MRI

FSE T2WI

Arterial Phase

Portal Venous

Equilibrium Phase

- Young women 30-50
 - After 50, less frequent and smaller (< 3cm)
- Benign hepatocellular lesion with a vascular central scar. Capsule -
- Single (<20% multiple)

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliates of HARVARD MEDICAL SCHOOL

Focal Nodular Hyperplasia

MR criteria (7):



- homogeneous lesion (except scar)
- iso/slightly hyperintense on T2-WI
- hyperintense scar on T2-WI
- high enhancement at the arterial phase (gd chelates)
- delayed enhancement of the scar on T1-WI
- absence of capsule

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliates of HARVARD MEDICAL SCHOOL

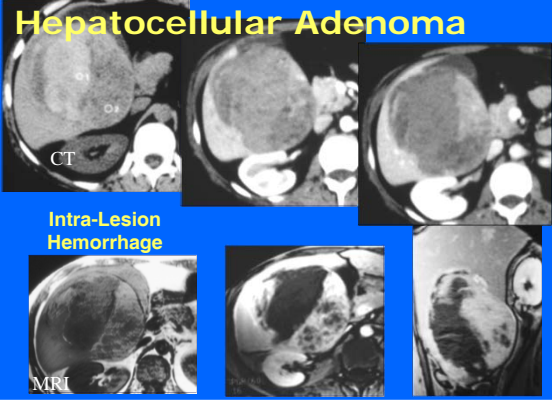
Focal Nodular Hyperplasia

- Characterization
 - Sensitivity : 74%
 - Specificity : 100%



Mathieu D et al. Gastroenterology 2000 Mar;118(3):560-4.

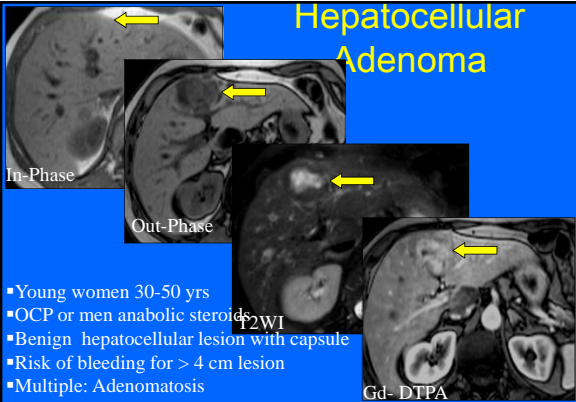
Hepatocellular Adenoma





Intra-Lesion Hemorrhage

Hepatocellular Adenoma



- Young women 30-50 yrs
- OCP or men anabolic steroids
- Benign hepatocellular lesion with capsule
- Risk of bleeding for > 4 cm lesion
- Multiple: Adenomatosis






Hepatocellular Adenoma: MR

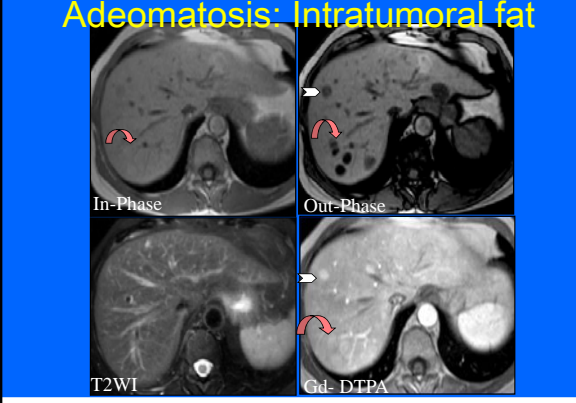
50-60% of hepatocellular adenomas are hyperintense on T1-WI



- Fat accumulation
- Hemorrhage
- Sinusoidal dilatation or peliosis

Mathieu D. Abdom Imaging. 1997; 22 : 410-7.

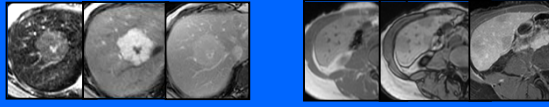
Adenomatosis: Intratumoral fat








FNH Vs. Adenoma: MRI Features

<p><u>Supporting FNH</u></p> <ul style="list-style-type: none"> ■ Scar ■ Homogenous enhancement 	<p><u>Supporting Adnoma</u></p> <ul style="list-style-type: none"> ■ Lipid (OP drop in SI) ■ Hemorrhage ■ Capsule
---	--



When in doubt, use of hepatobiliary MR contrast agent

Tissue Characterization: Morphologic Overlap (Central Scar)

FLC FNH HCC
Metastasis Carcinoid Hemangioma

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliate of HARVARD MEDICAL SCHOOL

FNH

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliate of HARVARD MEDICAL SCHOOL

Hepatobiliary Contrast Agents

Properties	MnDPDP (Teslascan)	Gd-BOPTA (Multihance)	Gd-EOB-DTPA (Eovist)
Dynamic	--	+++	++
H-B phase	+++ >10 min-hours	+ > 60 min-2 hrs	+++ <10 min-hrs
Biliary Excretion	50%	6%	50%
FDA	Approved Pulled out	Approved in US and EU	Approved in US and EU
Examples			

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliate of HARVARD MEDICAL SCHOOL

Tissue Characterization: H-B MR Contrast Agents

Seale MK et al. Radiographics. 2009 Oct;29(6):1725-48.

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliate of HARVARD MEDICAL SCHOOL

Multiple FNH's

Eovist

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliate of HARVARD MEDICAL SCHOOL

Gd-BOPTA- Liver Adenoma

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliate of HARVARD MEDICAL SCHOOL

EOB-MR: FNH and Adenoma

5 minutes 10 minutes

Adenoma

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliate of HARVARD MEDICAL SCHOOL

Fibrolamellar HCC

- Young age 30-50
- No cirrhosis
- Pathology
 - Heterogeneous lesion
 - Necrosis and hemorrhage
 - Fibrous/Calcified central scar
 - Nodes

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliate of HARVARD MEDICAL SCHOOL

Fibrolamellar HCC

- CT
 - Heterogeneous lesion
 - Calcified central scar

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliate of HARVARD MEDICAL SCHOOL

Fibrolamellar HCC

- MR
 - Heterogeneous lesion
 - Hypointense central scar on T2 WI

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliate of HARVARD MEDICAL SCHOOL

Fibrolamellar HCC

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliate of HARVARD MEDICAL SCHOOL

FNH Vs. FL-HCC: MRI Features

<p><u>Supporting FNH</u></p> <ul style="list-style-type: none"> ■ Scar-T2 Bright/delayed ++ ■ Lesion homogenous +++ 	<p><u>Supporting Adnoma</u></p> <ul style="list-style-type: none"> ■ Scar-T2 Dark/delayed- ■ Lesion heterogeneous ■ Enlarged LN
---	--

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliate of HARVARD MEDICAL SCHOOL

HB-MR and Liver Lesion

	Dynamic	(HB phase)	Other Comments
Cyst	No enhancement		
Metastasis	Hypo/Hyper ++	--	
Hemangioma	Usually characteristic peripheral nodular enhancement with centripetal progression	--	Large lesions may have a non-enhancing central scar
Adenoma	Hypervascular, but often not as vividly enhancing as FNH	-- w/BOPTA (Grazioli Radiol 2005) --/± with EOB not ++	No central scar; Intracellular fat in 60% Capsule
FNH	+++ iso to hyperintense to liver on PV phase	+++ iso or hyperintense to normal liver Scar --	Central scar in 80% usually T2 +, delayed ++
FL-HCC	Heterogeneous	variable enhancement	Commonly have a T1 and T2 hypointense, non-enhancing central scar.

MR: Diffusion Weighted Imaging (DWI)

■ Uses of DWI:

- Tissue Characterization:
 - » Lesion Detection
 - » Lesion characterization
 - » *Malignant tumors show restrict diffusion*
- Functional Evaluation
 - » Biomarker of tumor treatment response

Koh DM et al. Eur Radiol. 2008 May;18(5):903-10.
Brugge M et al. Eur Radiol. 2009 Mar;19(3):677-85.
Lauric V et al. Eur J Radiol. 2009 Jun; 2
Catalano OA. Radiology. 2010 Jan;254(1):154-62.

Advanced MR Techniques: Diffusion Weighted Imaging

DWI: MALIGNANT LESIONS Restricted Diffusion

	DWI (b400)	ADC
Metastases		
HCC		
Cholangio CA		

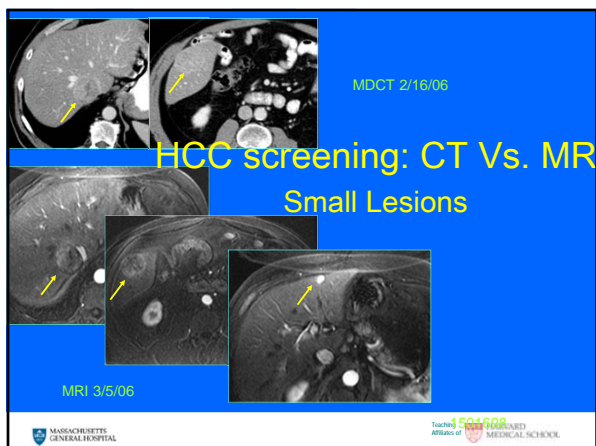
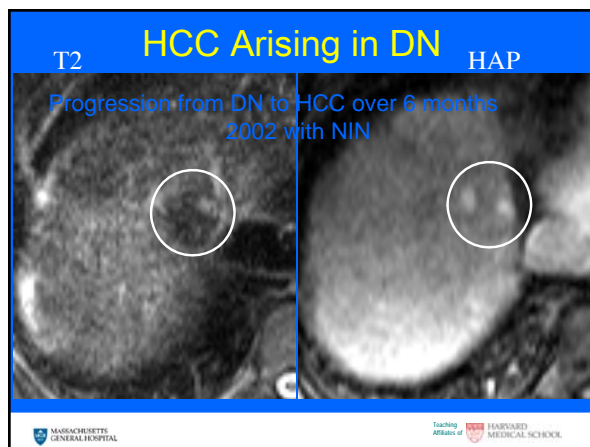
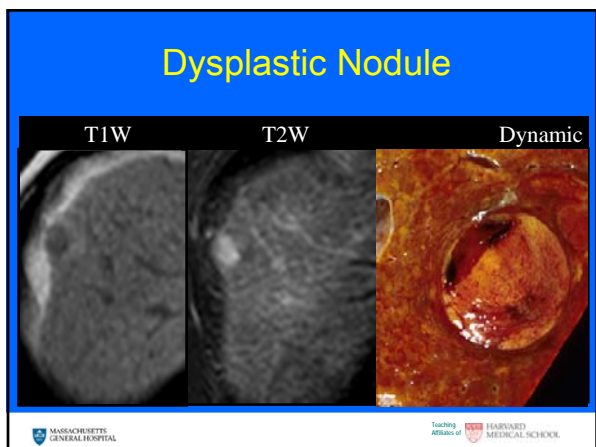
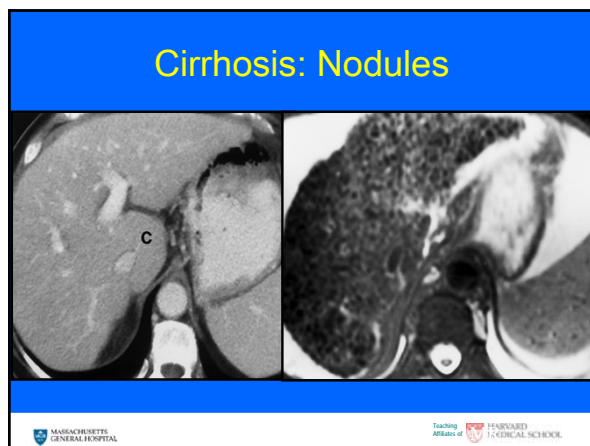
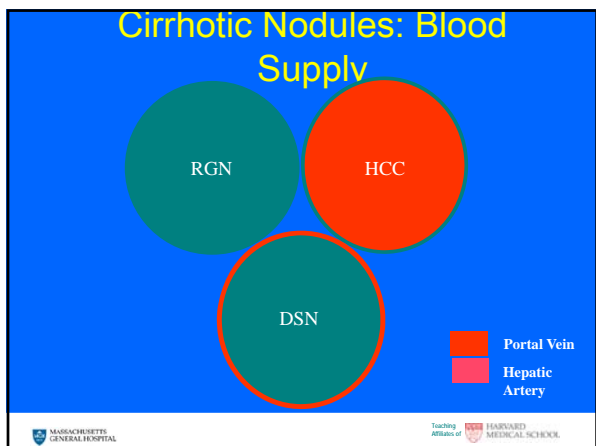
Primary Malignant Tumors

- HCC
- Fibrolamellar HCC
- Cholangiocarcinoma

Malignant Transformation In Cirrhosis

14-38% of cirrhotic liver have DNs
DN is a premalignant lesion and a target for HCC prevention

Courtesy: Glenn Krinsky NYU



HCC in Cirrhotic Liver: Spectrum

- Imaging appearance depends
 - Size of the lesion
 - Patterns of Growth of HCC
 - Tumor biology/angiogenesis

MASSACHUSETTS GENERAL HOSPITAL Teaching Affiliate of HARVARD MEDICAL SCHOOL

HCC : Vascular Invasion

Tumor Thrombus
PV Expansion
Enhancement
Portal vein

Gd-DTPA MRI

Shah ZK. AJR Am J Roentgenol. 2007 May;188(5):1320-3.
 Catalano OA. Radiology. 2010 Jan;254(1):154-62.

MRI: Cirrhosis & Pseudolesions

HAP

HAP

No SI changes on T1/T2
 4-6 months FU

Detection of HCC in Cirrhosis Explant correlation

CT	CT*	MRI
71% (15/21)	37% (30/82)	53% (11/19)
■ <2cm 60%	Mean size	< 1CM 33%
■ 2-5 cm 82%	Detected 24 mm	1-2 CM 50%
	Undetected 13 mm	> 2CM 80%
	*Triple CT	

Lim AJR 2000 Peterson Radiology 2000 Krinsky Radiology 2001

Recent studies showing MR accuracy > 70%.
 False +ve and False-ve reduced with the new Tx criteria of lesion >2cm size

Cirrhosis and Eovist

- 95% HCC are hypointense in H-B phase
 – Kim SH et al AJR 2009
- At risk nodule for HCC development
 – (high grade DSN/WD-HCC)
 – No arterial enhancement and not T2 bright
 – Lacks CM uptake in HB-phase
 – Holland et al. Invest Radiology 2010

MD-HCC

Hypothetical mechanism of gadoxetic acid accumulation in HCC.

gadoxetic acid

OATP1B1/3

sinusoid

MRP2

tumor cell

canaliculus



lumen of canaliculus/pseudogland

pseudogland

Tsuboyama T et al. Radiology 2010;255:824-833



Improved HCC Detection

- 59 patients with 84 HCCs
- EOB-enhanced MR imaging
 - 1.5-T in 19 and a 3.0-T system in 40 patients
- For all observers, A(z) values were higher with HB-phase MR.
- HB-phase MR improved performance of least experienced reader (2 years) A(z), from 0.895 in set 1 to 0.951 (P = .049).
- Nine HCCs (10.7%) in six patients (10.1%) were seen only on HB-phase images.

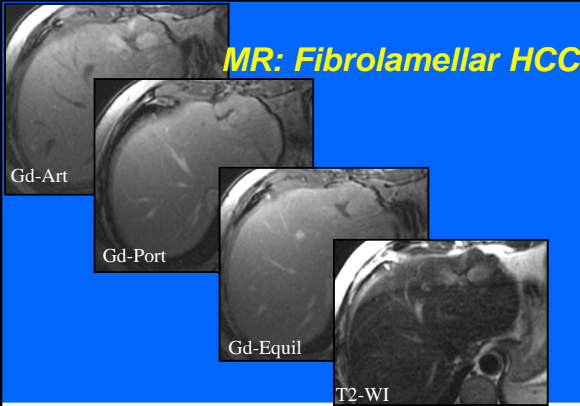





HB-MR and Cirrhotic Nodules

Lesion	T1	T2	Dynamic	HB-Phase
RGN	Iso-Hyper	Iso-Hypointens	Enhance in PV phase	++
WD-DSN	Often hyper	Iso-Hypointens	Enhance in PV phase	++
PD-DSN	Variable	Mildly hyper	+/- arterial phase	+/-
WD-HCC	Variable	Hyperintense	++ arterial phase	--/+
MD-HCC	Usually heterogeneous	Hyperintense	80-90% ++ in arterial phase	--/?+
PD-HCC	Heterogeneous	Hyperintense	80-90% ++ in arterial phase	--

MR: Fibrolamellar HCC

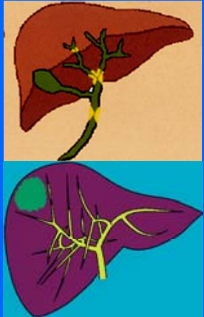




Cholangio Carcinoma

Rare - 3000 deaths USA 2002 vs. 16,600 HCC

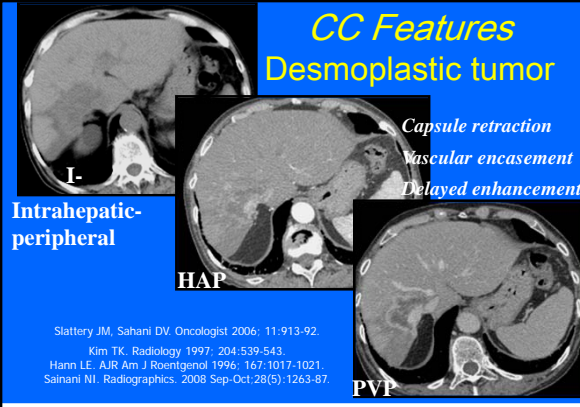
- 60%-65% at hilar bifurcation
- 20-30 % at distal CBD
- 10-15 % in the liver
- 5 % multi-focal





Khan SA. Gut 2002; 51 Suppl 6:VII-9

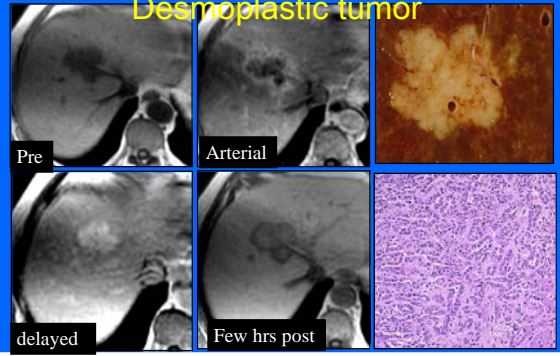
CC Features Desmoplastic tumor





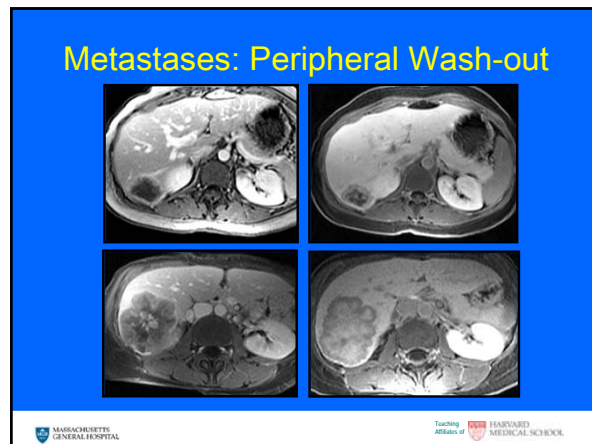
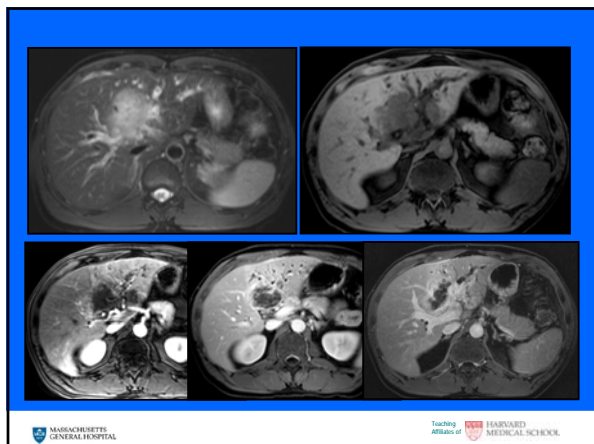
Slattery JM, Sahani DV. Oncologist 2006; 11:913-92.
 Kim TK. Radiology 1997; 204:539-543.
 Hann LE. AJR Am J Roentgenol 1996; 167:1017-1021.
 Sainani NI. Radiographics. 2008 Sep-Oct;28(5):1263-87.

CC Features Desmoplastic tumor





Liver Mets: MR vs. FDG-PET

PET Sensitivity
 Lesions > 2 cm = 100%, 30-60% lesions < 1 cm
 Post-ChemoTx : 63% overall sensitivity

Modality	Metastases	Lesions < 1cm
FDG-PET	65	12
MRI	88	33

Kinkel. Radiology 2002. Sahani. AJR 2005. Akhurst T. JCO 2005.
 Coenegrachts K. Radiology 2009.

Image Guided Biopsy of < 3 cm Lesions: Accuracy > 95% (MGH Data)

Summary

- CE-MRI is a highly accurate for liver lesion characterization
 - Liver specific contrast agents and DWI has further empowered MR
- Recognition of imaging features typical of a benign lesions is most crucial
- Role of PET/PET-CT is evolving
 - Extrahepatic disease
 - Problem Solving
- Image guided FLL biopsy is safe and highly accurate

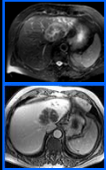
Approach to focal liver lesion

Look for Characteristic Features

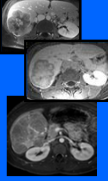
<div style="border: 1px solid white; border-radius: 50%; padding: 5px; display: inline-block;">Common benign lesions</div>	<div style="border: 1px solid white; border-radius: 50%; padding: 5px; display: inline-block;">Malignant Lesions</div>
<ul style="list-style-type: none"> ■ Hemangioma ■ FNH ■ Adenoma 	<ul style="list-style-type: none"> ■ Heterogeneity ■ Wash-out ■ Capsule Retraction ■ Vascular invasion ■ Biliary obstruction

Suspicious Features (non FNH/Hemangioma) or Malignant


Heterogeneity



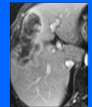
Wash-out



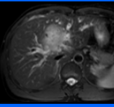
Hemorrhage



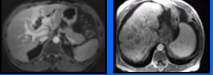
Capsular
Retraction





Biliary
Obstruction



Vascular Encasement/Invasion







Summary

- Advances in CT and MR technique
 - Improved HCC detection
 - Candidate selection for optimal therapy
- Dynamic HAP imaging with CT and MR is essential for best results.
- Screening strategy and choice of imaging dependent on local expertise
 - Dynamic MR best for small lesion detection and characterization

