Imaging of liver tumors: what's new?

Valérie Vilgrain
Dept of Radiology
Beaujon Hospital, Paris, France

Université de Paris

CONFLICT OF INTEREST

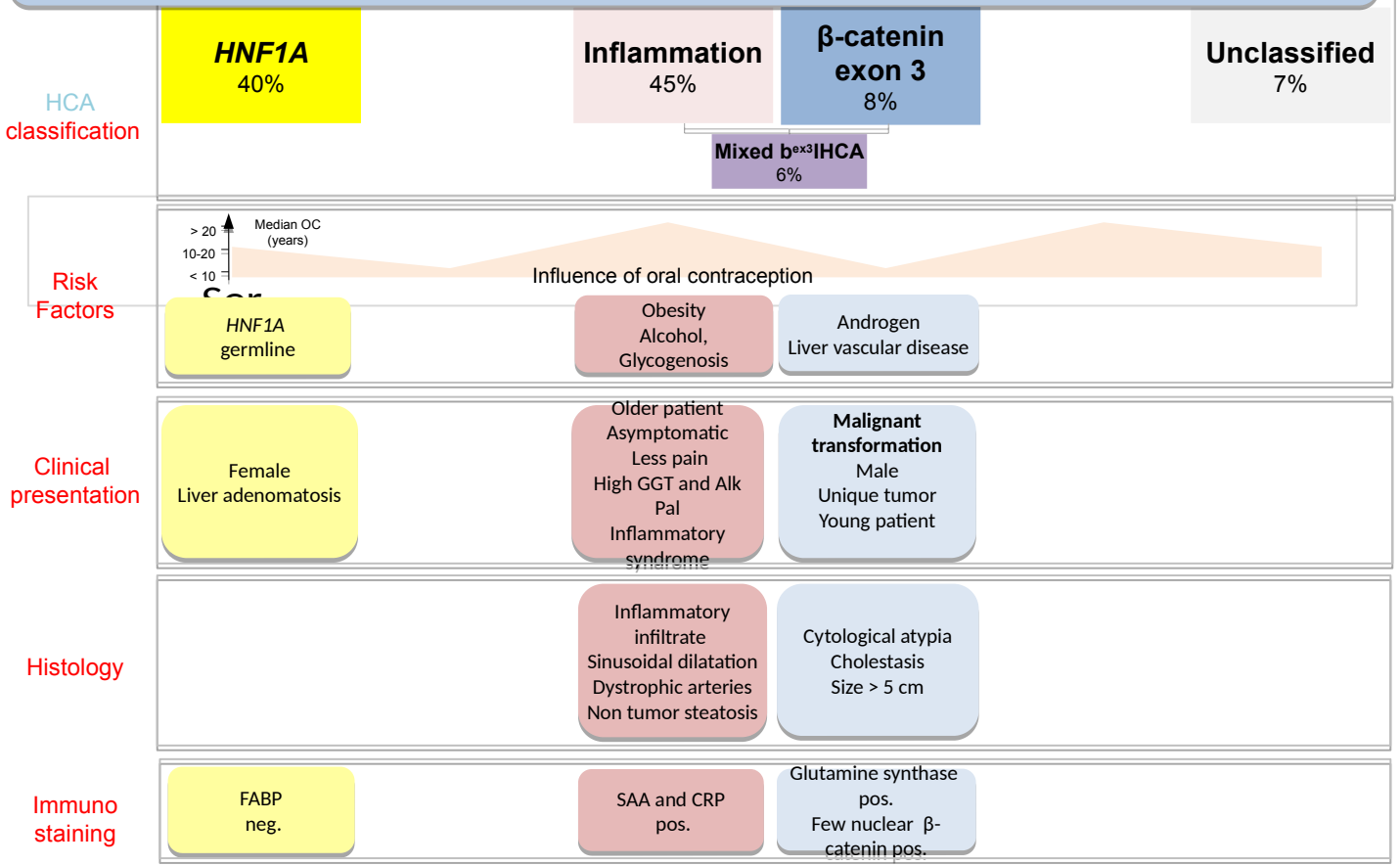
None

Outline

- What’s new for diagnosing hepatocellular adenomas?
- What’s new for screening malignant liver tumors?
- What’s new for diagnosing hepatocellular carcinomas?
- What’s new for staging malignant liver tumors?
- What’s new for quantitative imaging of liver tumors?

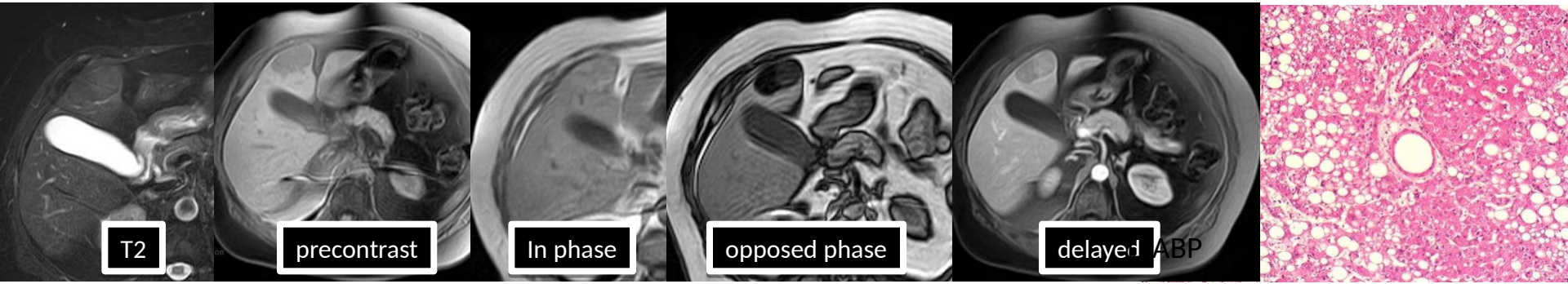
HEPATOCELLULAR ADENOMAS

HCA: genotype/phenotype classification

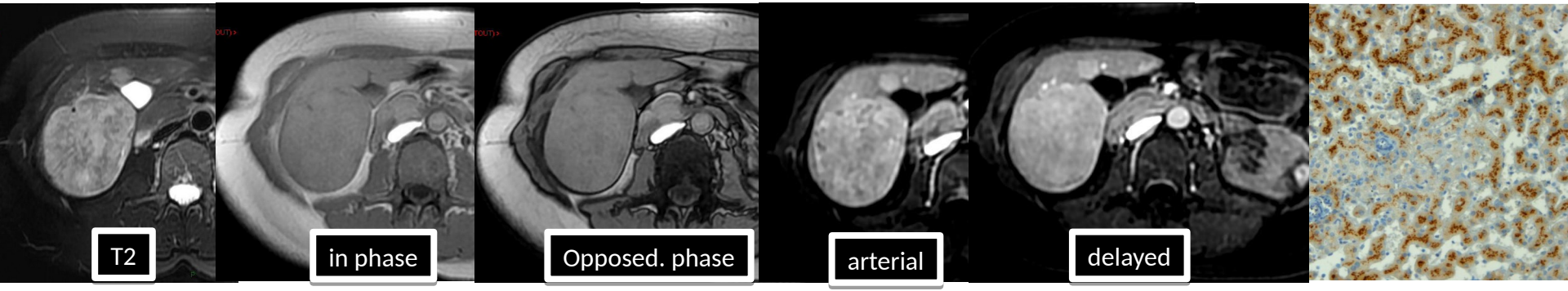


Nault JC, Gastroenterology 2017

HNF1-α and Inflammatory



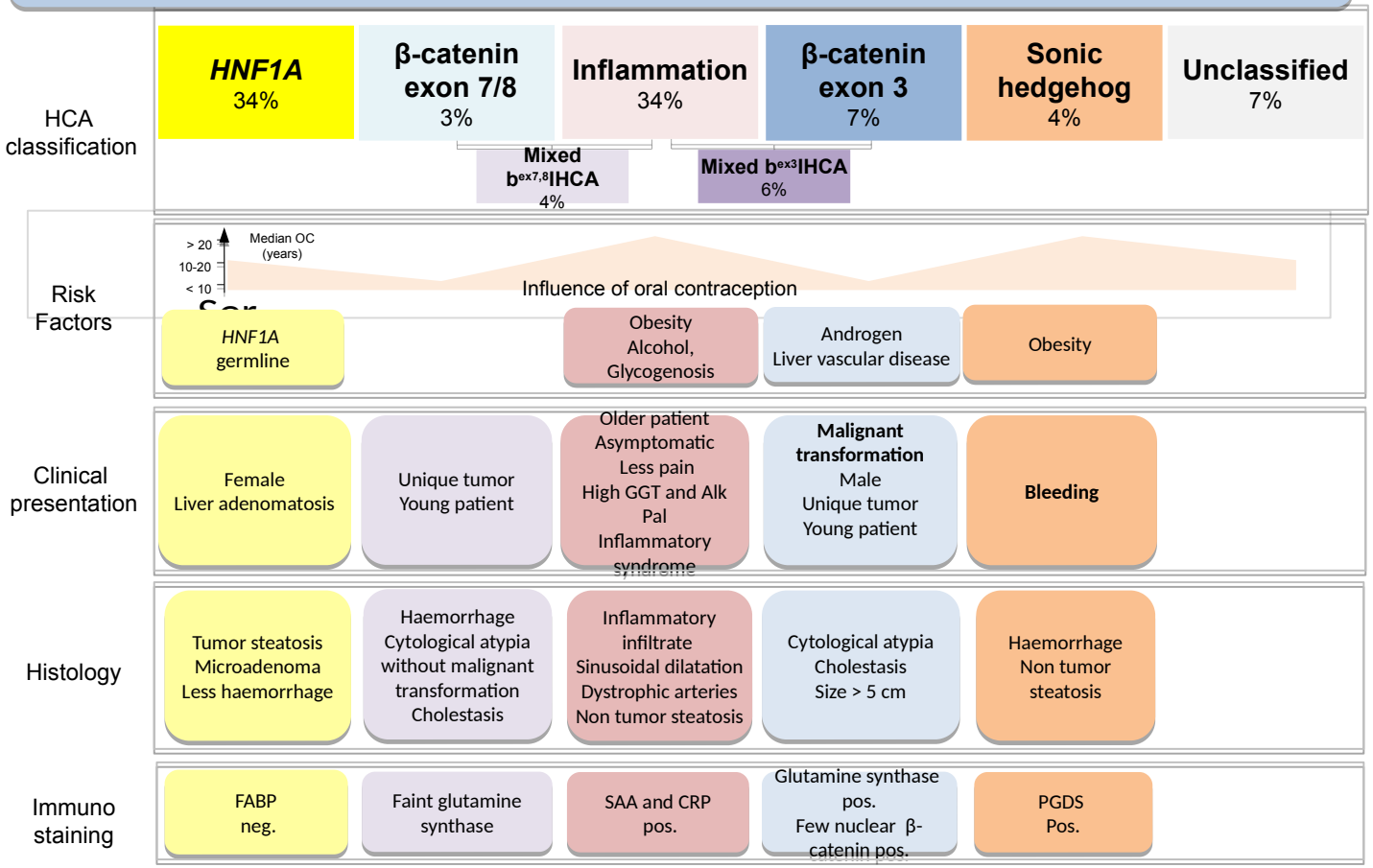
HNF1-α: Marked signal drop on opposed-phase T1 MR



Inflammatory: hypersignal on T2 AND persistent enhancement on delayed phase

Laumonier Hepatology 2008, Ronot Hepatology 2011

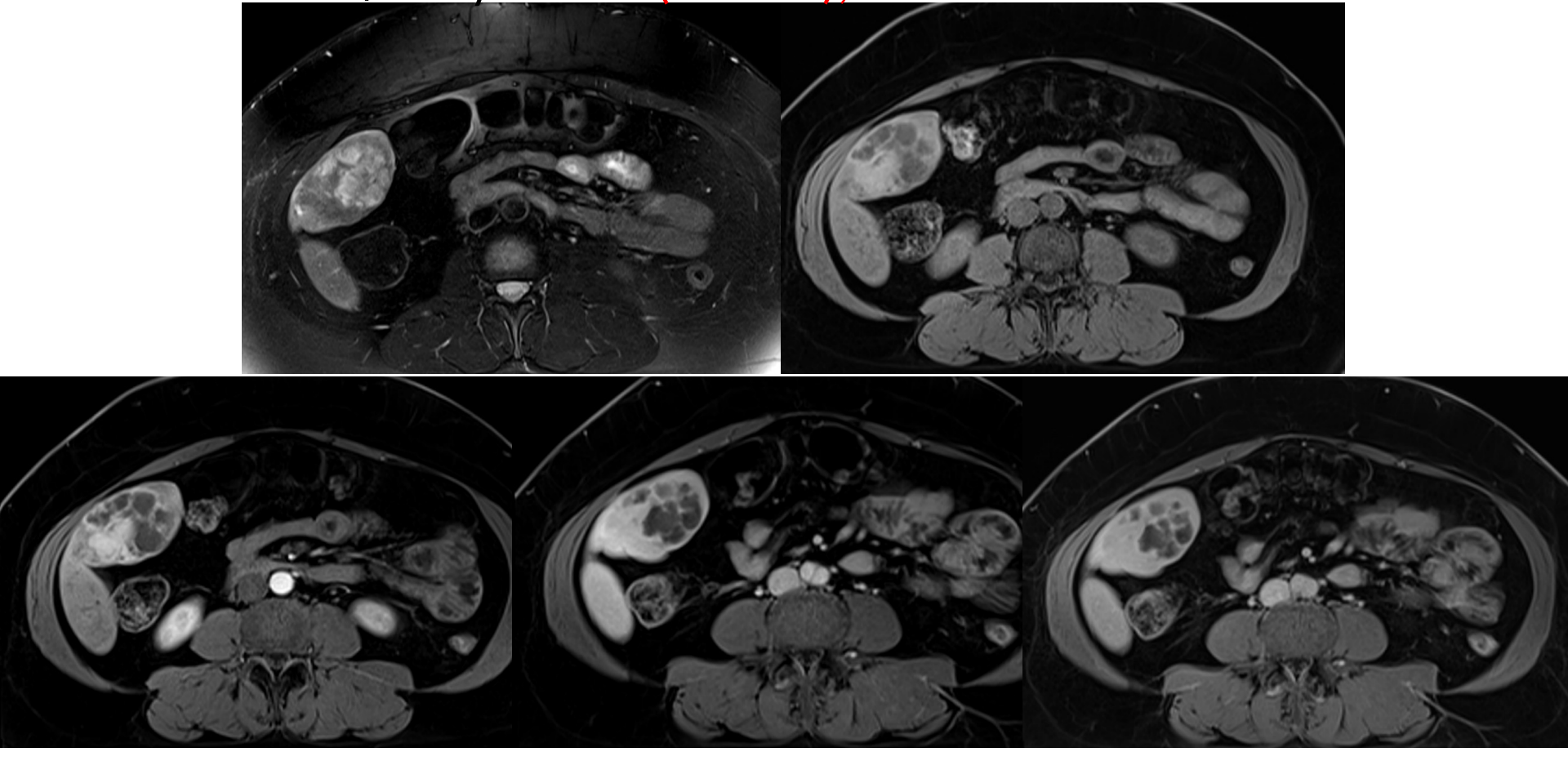
2016, new molecular subtypes

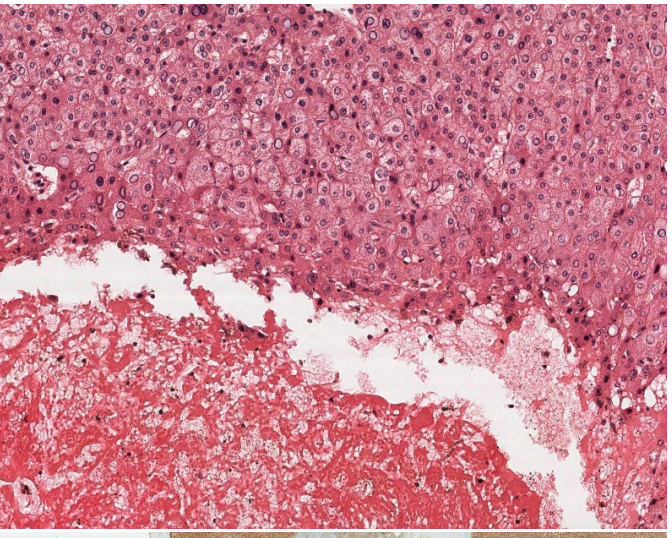


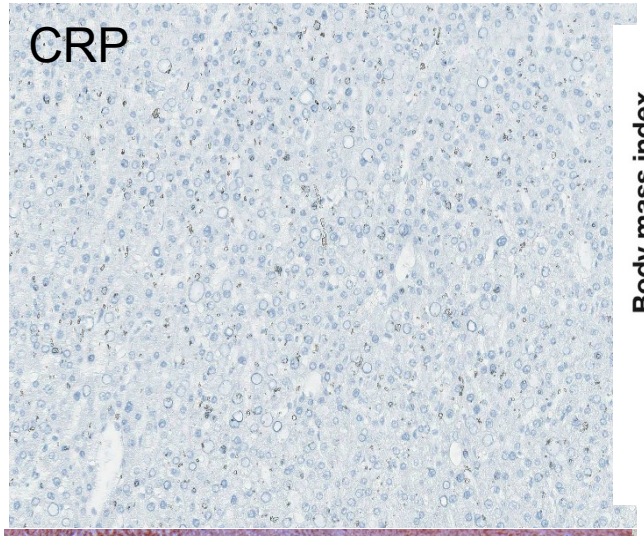
Nault JC, Gastroenterology 2017

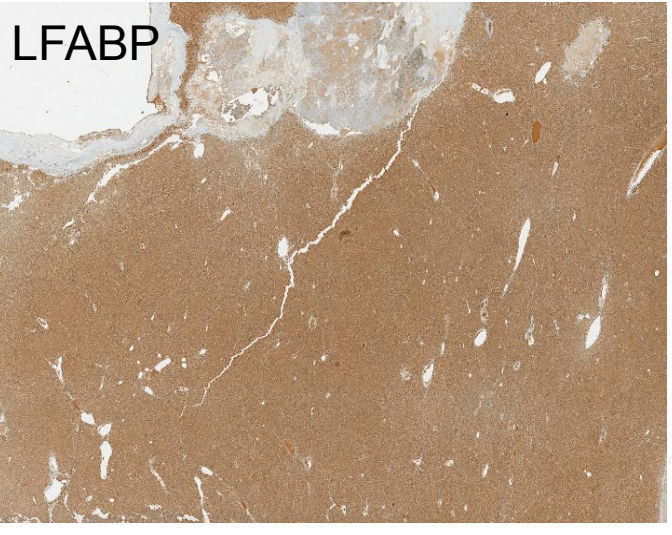
Sonic Hedgehog

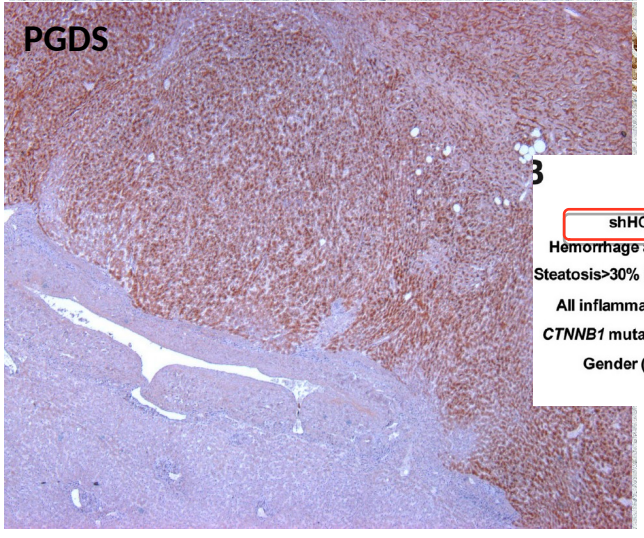
♀ 35 year-old (BMI 32), 6 cm liver nodule

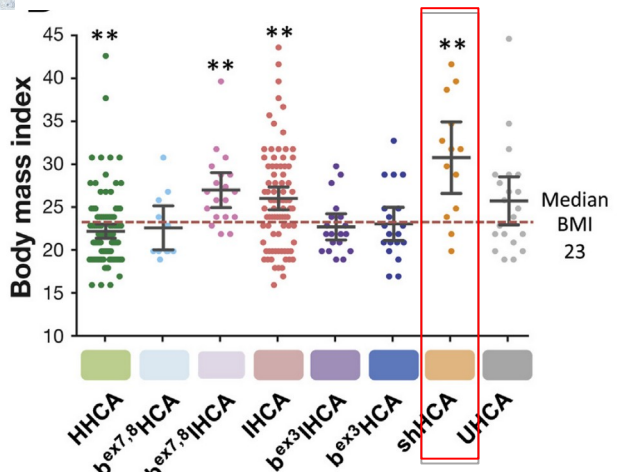


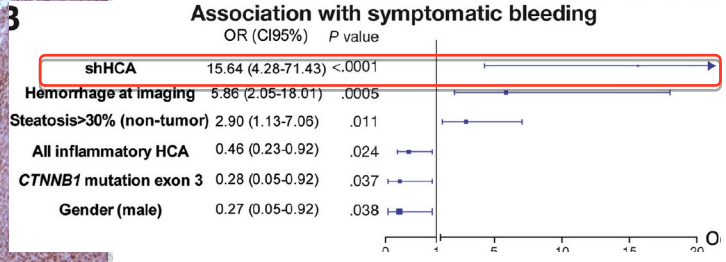



CRP

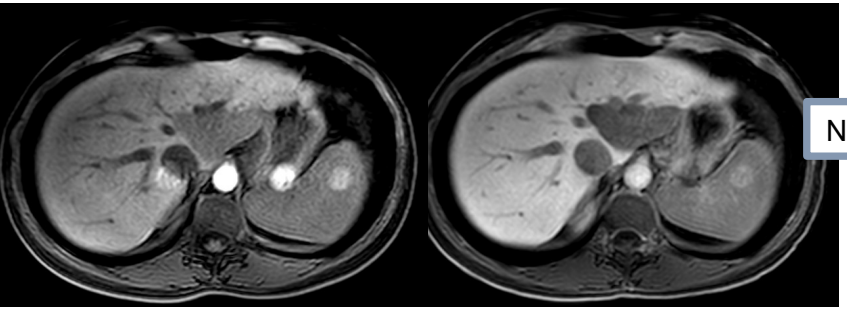

LFABP


PGDS

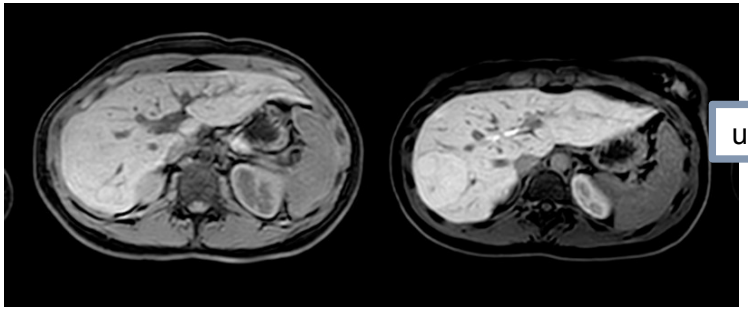

Body mass index
45
40
35
30
25
20
15
10
**
**
**
**
Median
BMI
23
HHCA
bex7,8HCA
bex7,8IHCA
IHCA
bex3IHCA
bex3HCA
shHCA
UHCA


Association with symptomatic bleeding
OR (CI95%)
P value
shHCA
15.64 (4.28-71.43)
<.0001
Hemorrhage at imaging
5.86 (2.05-18.01)
.0005
Steatosis>30% (non-tumor)
2.90 (1.13-7.06)
.011
All inflammatory HCA
0.46 (0.23-0.92)
.024
CTNNB1 mutation exon 3
0.28 (0.05-0.92)
.037
Gender (male)
0.27 (0.05-0.92)
.038

β-catenin exon 3: hepatobiliary MRI phase

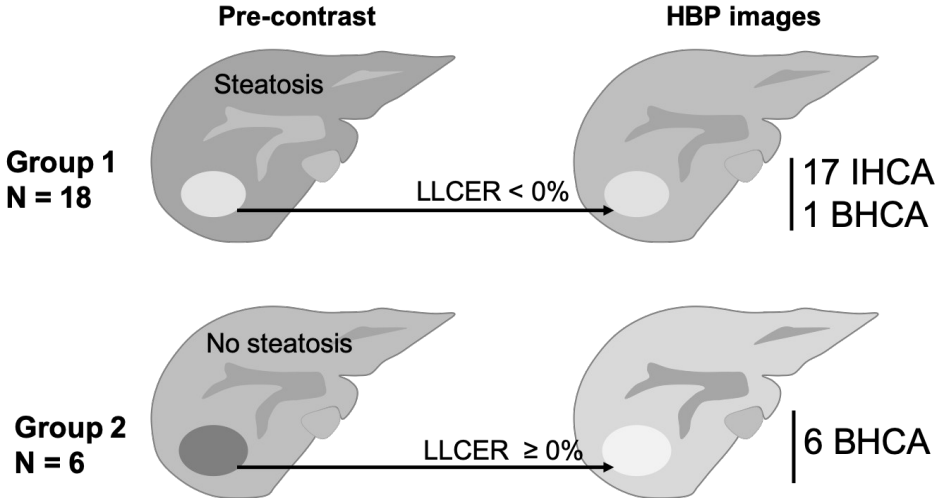


No uptake



uptake

positive contrast uptake on hepatobiliary phase MRI might be a good indicator of the presence of bex3 activation



SCREENING LIVER MALIGNANCIES

Screening: HCC

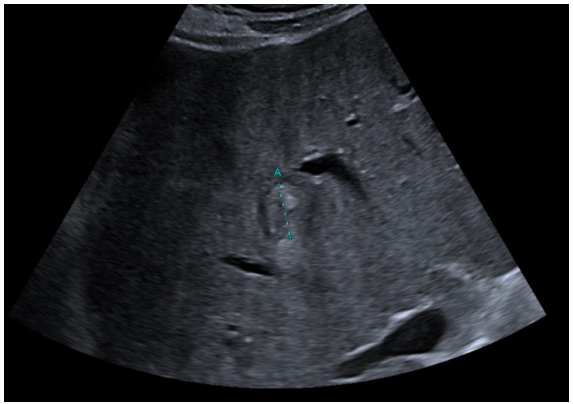
Clinical Practice Guidelines

JOURNAL OF HEPATOLOGY

EASL Clinical Practice Guidelines: Management of hepatocellular carcinoma☆

Surveillance should be performed by experienced personnel in all high-risk populations using abdominal ultrasound every six months (**evidence moderate; recommendation strong**)

- Performance of US
  - Disappointing
  - Meta-analysis
    - all HCCs: Se 84% (CI 76%-92%)
    - early-stage HCC: Se 47% (CI 33%-61%)



Tzartzeva K, Gastroenterology 2018

Screening: HCC with abbreviated MRI

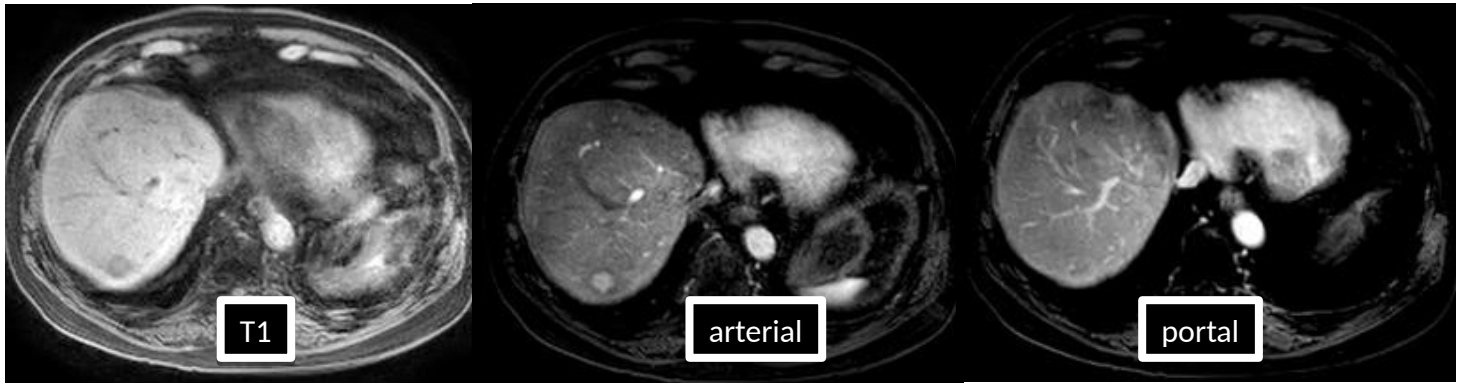
- Why?
  - MRI is more sensitive than CT
  - Some sequences have a better performance
    - T2, diffusion, Hepatobiliary phase (HB agents)
    - Only dynamic phase
  - Less expensive
  - Fast (10 min)

Marks, AJR 2015

Screening: HCC with abbreviated MRI

Scenario 1

Scenario 2



Screening: HCC with abbreviated MRI

174 patients including 62 with HCC	DWI+HBP+T2	Contrast-enhanced set
Se.	80.6%	90.3%
NPV	80%	94.9%

Higher specificity and positive predictive value for CE-set
DWI and T1w-HBP has a clinically acceptable sensitivity and NPV for HCC detection

164 consecutive HCC screening MRIs
CE set with extracellular CA vs. full liver MRI
only 5% of cases changing LI-RADS categorization due to the inclusion of T2 and DWI

abbreviated MRI will probably play a greater role as a surveillance tool in patients at risk of HCC. **first-line surveillance tool? in patients in whom US is difficult? very high risk patients ?**

Besa, Abdominal Radiology 2017; Lee JY, Abdominal Radiology 201

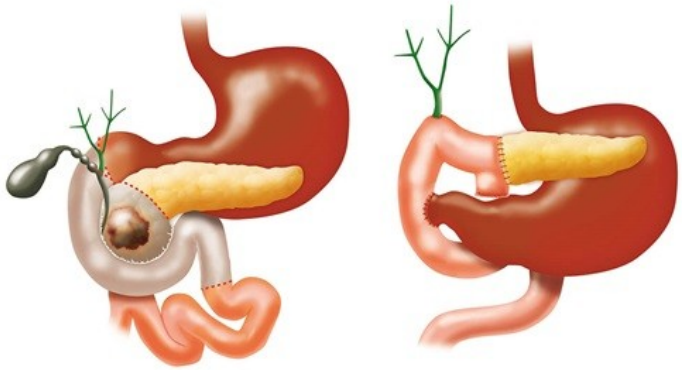
Screening: liver metastases with MRI

- retrospective study
- gadoxetic acid-enhanced MRI scans of 57 patients (43 with pathologically proven CRLMs)
- T2+T1-HBP at 20 min+DWI vs. Full liver MRI
- Se and AUCs of abbreviated MRI > 90%. Not different from full MRI
- Acquisition time be less than 10 min

Canellas R, European Radiology 2019

Screening: liver metastases with MRI

- Not for all cancers!
- NPV of CT considered high
  - Negative-liver-on-CT patients gave the MRI yield of 0% (0/94)
- For those with:
  - High likelihood of liver metastases
  - Complex surgery of primary cancer

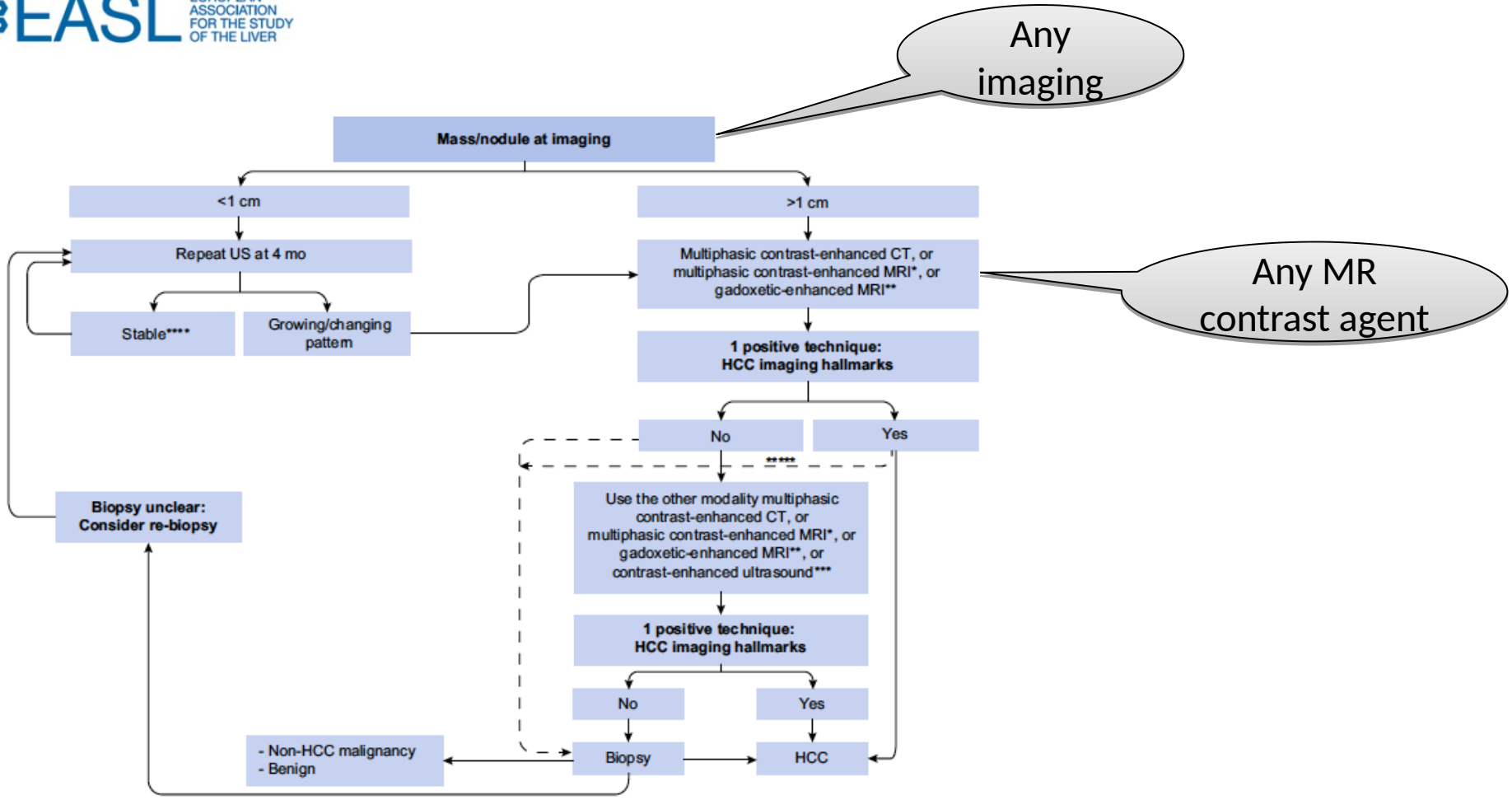


Pancreatic adenocarcinoma

Han K, Ann Surg 2015

DIAGNOSING HCC

EASL EUROPEAN ASSOCIATION FOR THE STUDY OF THE LIVER



Dx of HCC on MRI: which contrast agent?

Advantages extracellular agent

- Better arterial phase
- Better visualization of wash-out
- Better diagnostic performance for diagnosis

diagnosis

Advantages Gadoxetic acid

- Increased detection of nodules including atypical HCC or nodules that can evolve into HCC
- Increased detection of additional HCCs in patients considered as having single-nodular HCC
- Prognostic factor of HCC

staging

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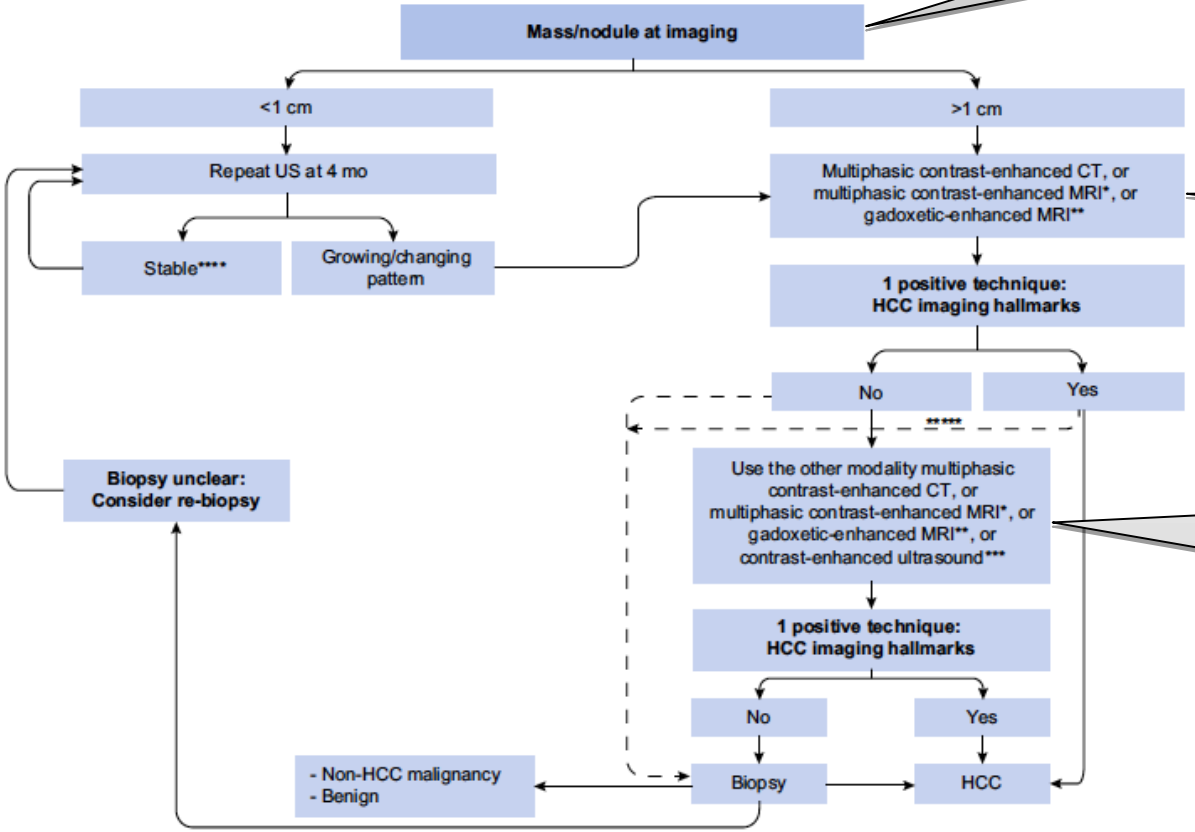


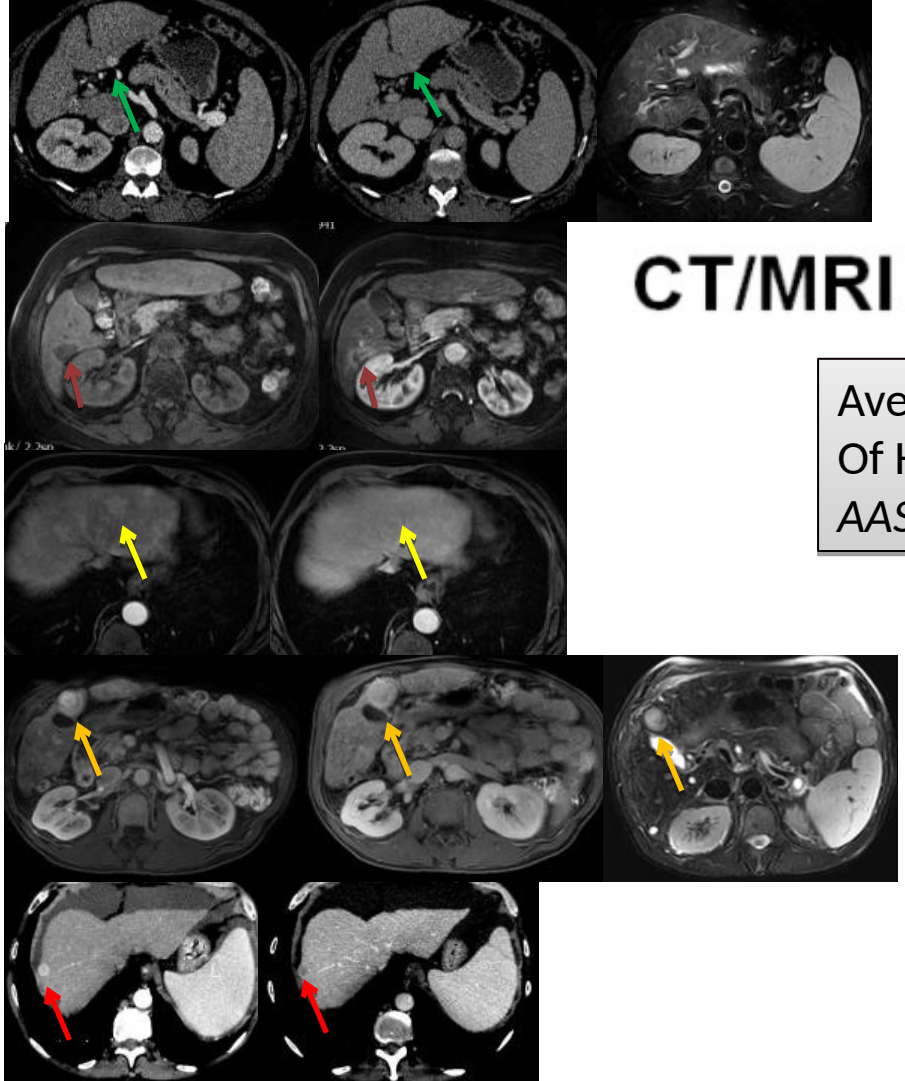
Any imaging

Any MR contrast agent

2nd ex if the 1st is unconclusive CEUS possible

CT/MRI LI-RADS®

0 %	LR-1
11%	LR-2
42%	LR-M
33%	LR-3
80%	LR-4
96%	LR-5



Average probability
Of HCC
AASLD 2018

STAGING LIVER MALIGNANCIES

Staging: common principles

intrahepatic

Number of tumors
Location
- unilobar/bilobar
- major vessels

Vessel involvement

HCC and cholangioCa

extrahepatic

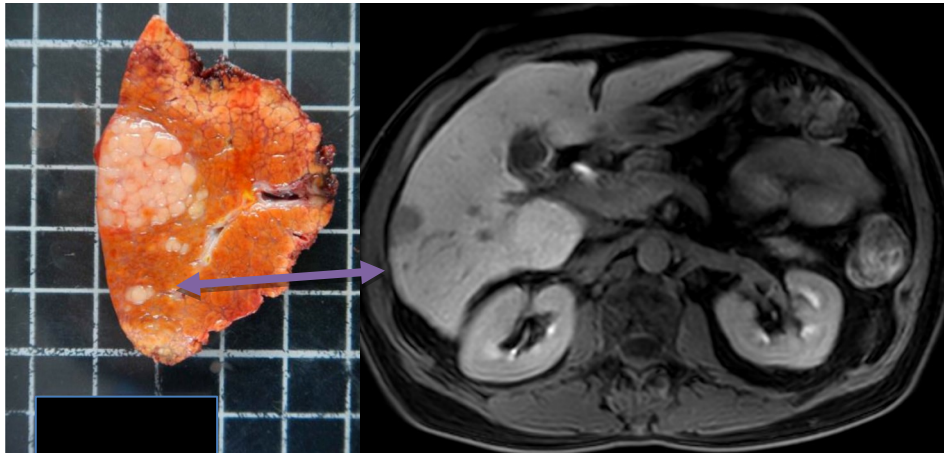
cholangioCa and LM

lymphadenopathy
Peritoneal carcinomatosis
Distant metastases
- lung
- bone
- adrenal…

cholangioCa and LM

Staging is especially important when resection or locoregional treatments are considered

Intrahepatic staging: MRI



MR > CT for diagnosis of HCC
Gadoxetic MRI >> CT for intrahepatic staging

Intrahepatic staging: MRI

Maarten Christian Niekel, MSc
Shandra Bipat, PhD
Jaap Stoker, MD, PhD

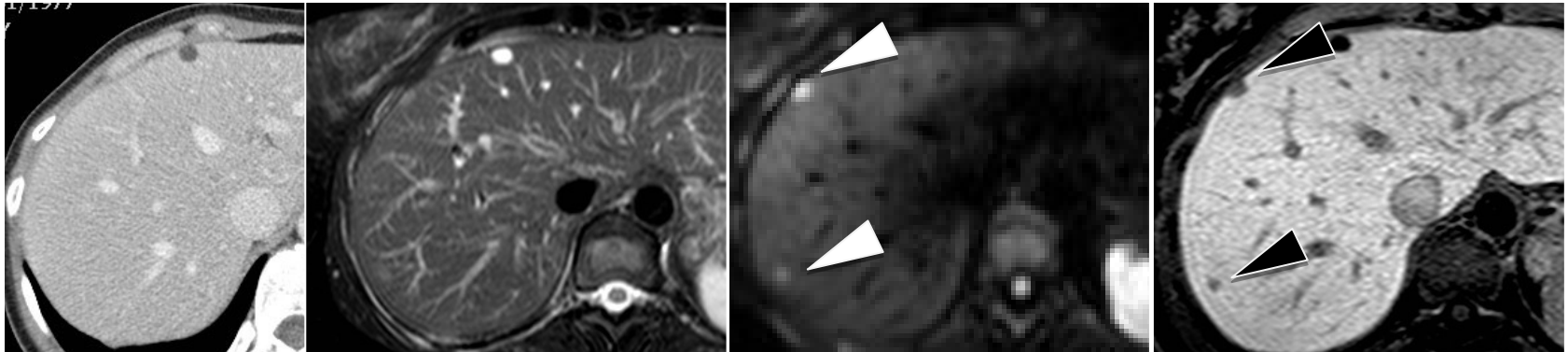
Diagnostic Imaging of Colorectal Liver Metastases with CT, MR Imaging, FDG PET, and/or FDG PET/CT: A Meta-Analysis of Prospective Studies Including Patients Who Have Not Previously Undergone Treatment[1]

Radiology

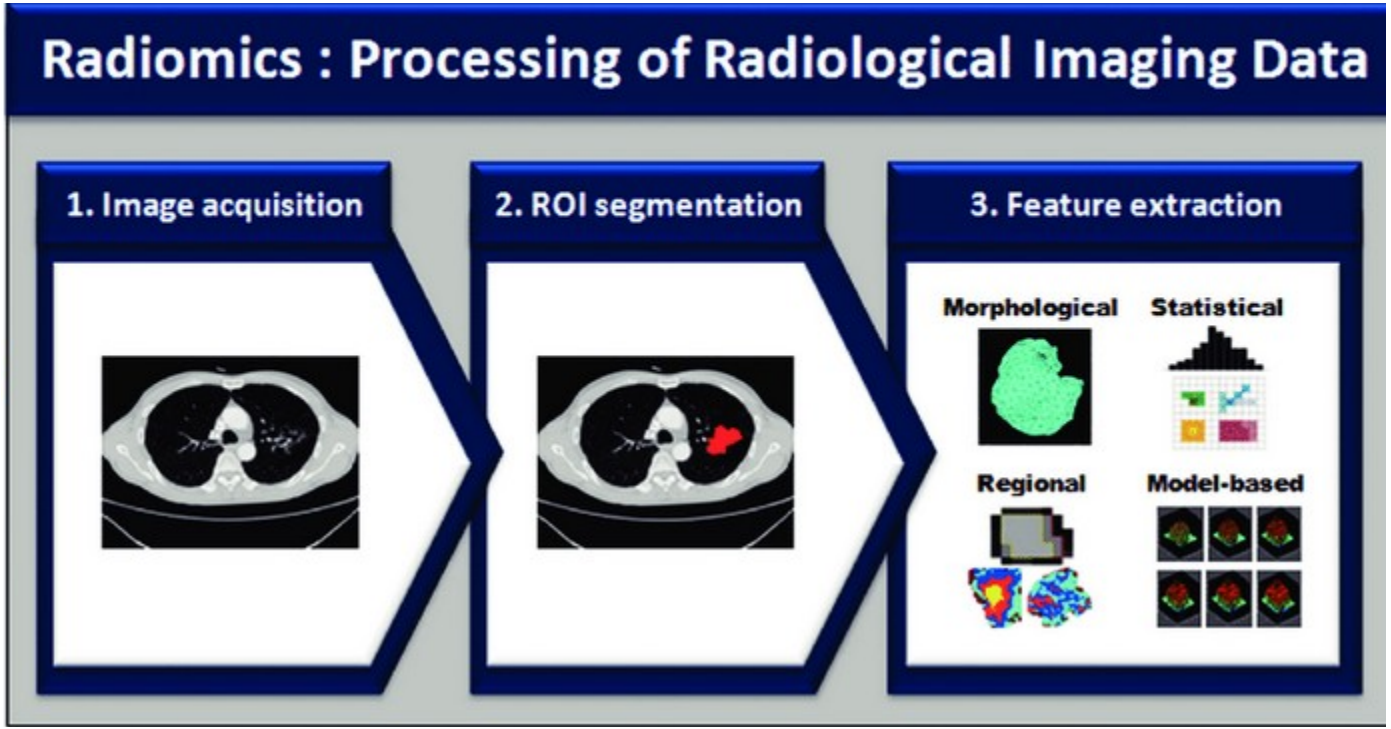
Meta-analysis in liver mets 36 articles (1747 patients, 3379 metastases)
Vilgrain Europ Radiol 2016

MRI	Se (%)
Diffusion	87.1%
HBP (gadoxetic)	90.7%
Both	95.7%

MR imaging is the preferred first-line modality



QUANTITATIVE IMAGING



conversion of digital medical images into mineable high-dimensional data

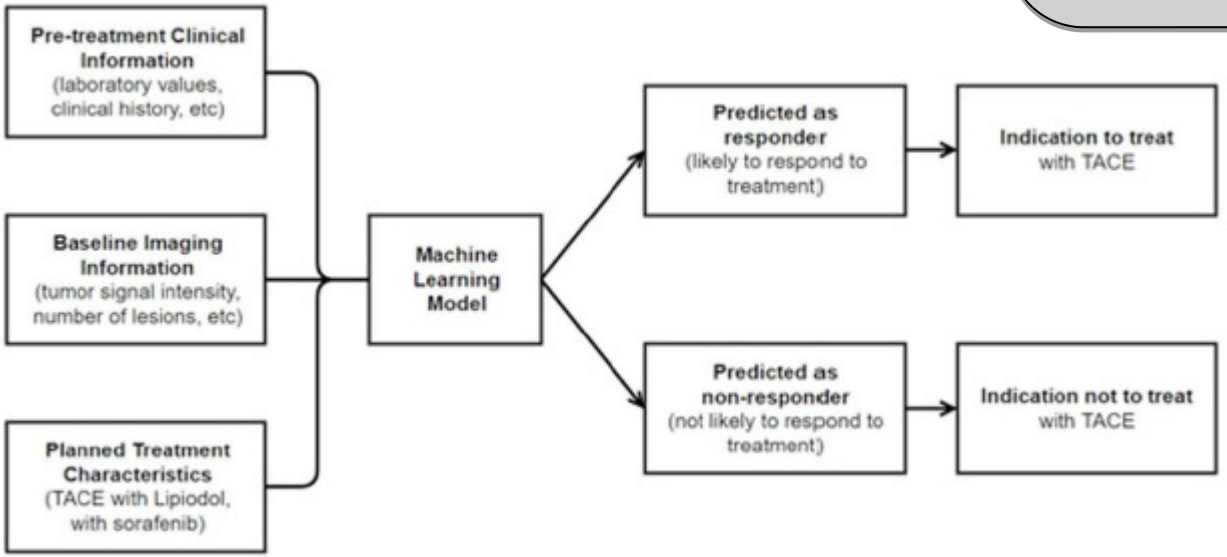
The idea is that medical images contain information (not visible to the naked eye) that reflects underlying pathophysiology and that these relationships can be determined via quantitative image analyses

J Vasc Interv Radiol. 2018 June ; 29(6): 850–857.e1. doi:10.1016/j.jvir.2018.01.769.

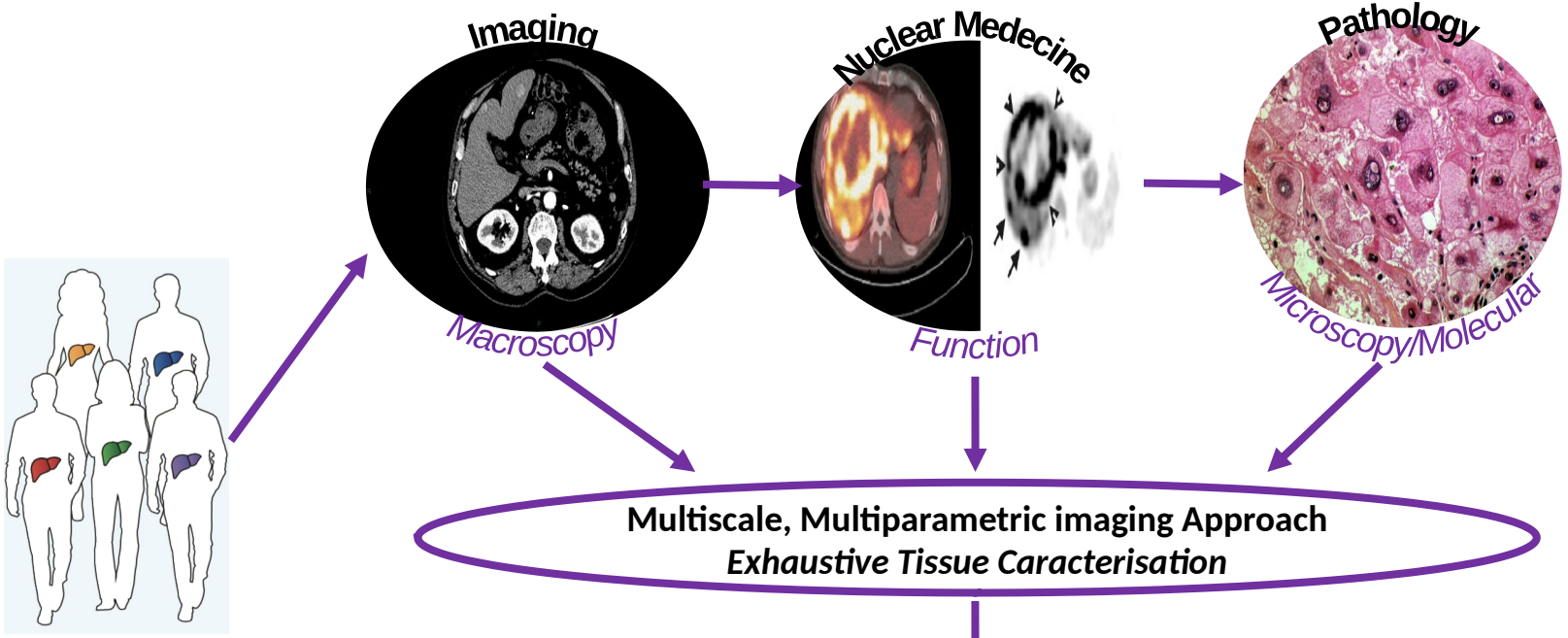
Predicting Treatment Response to Intra-arterial Therapies of Hepatocellular Carcinoma using Supervised Machine Learning—An Artificial Intelligence Concept

Aaron Abajian, M.D.[1], **Nikitha Murali, BA**[1], **Lynn Jeanette Savic, M.D.**[1,2], **Fabian Max Laage-Gaupp, M.D.**[1], **Nariman Nezami, M.D.**[1], **James S. Duncan, PhD**[3], **Todd Schlachter, MD**[1], **MingDe Lin, PhD**[4], **Jean-François Geschwind, MD**[5], and **Julius Chapiro, MD**[1]

Strongest predictors of treatment response (acc 78%)
Clinical variable (presence of cirrhosis)
Imaging variable (tumor SI >27)



MOSAIC: A Concept



Conclusion

- Liver imaging is improving in many ways: diagnosis and characterization
- There are new questions regarding imaging screening of liver malignancies
- Quantitative imaging benefits from mathematics and AI