Challenges in diagnosis of hepatocellular carcinoma

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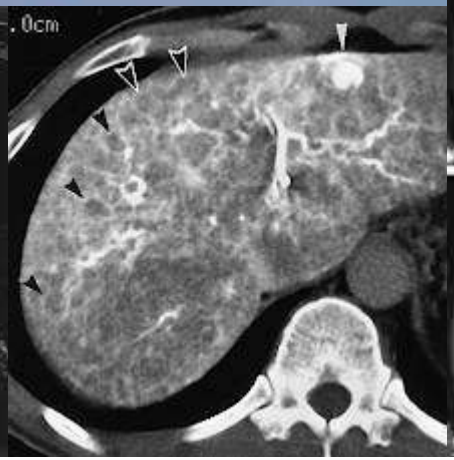
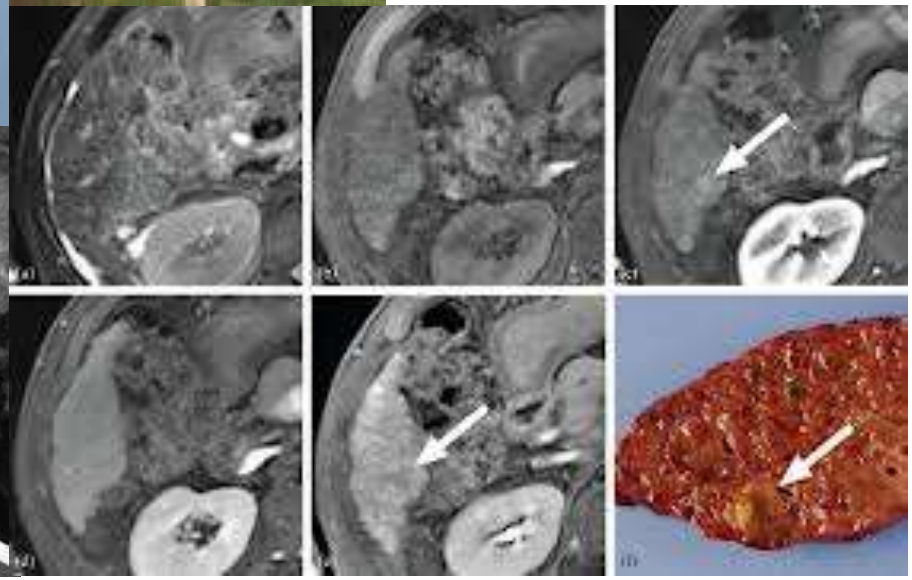
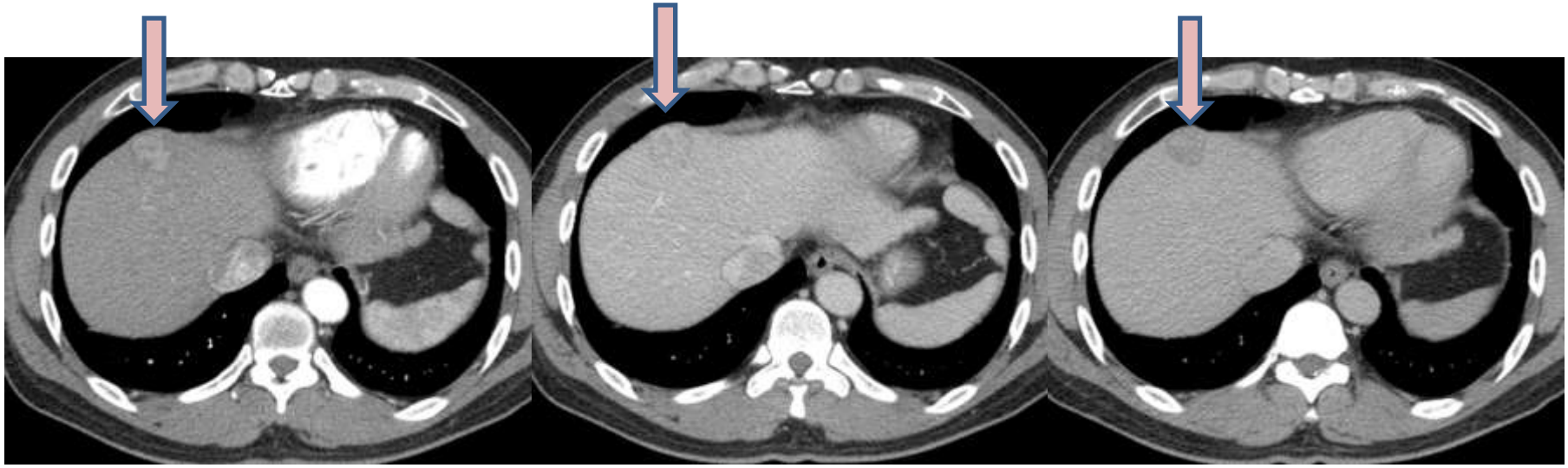
Liver nodule



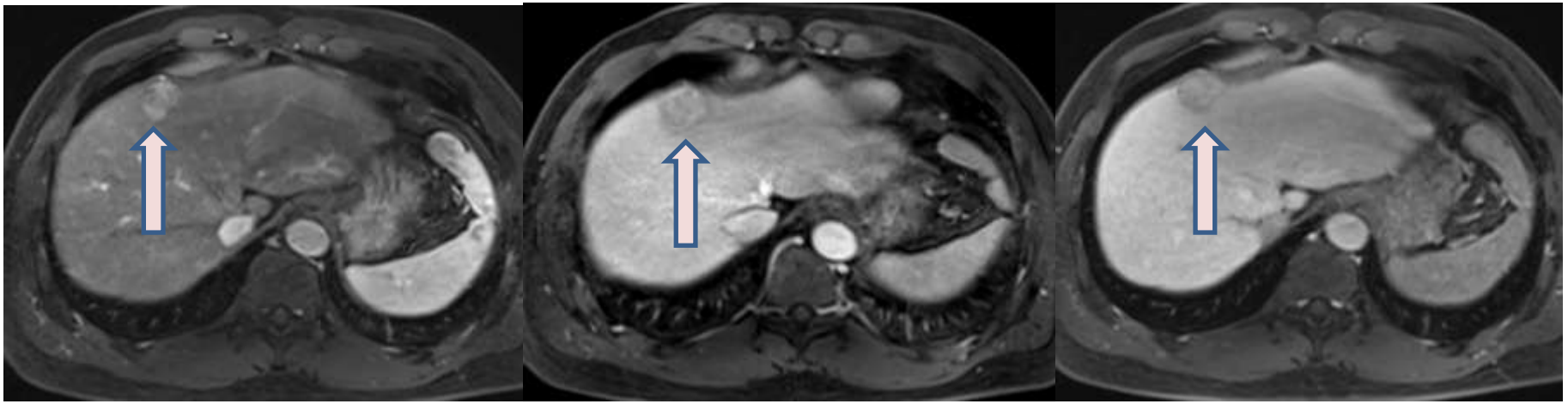


Diagnosis of HCC: Typical imaging findings

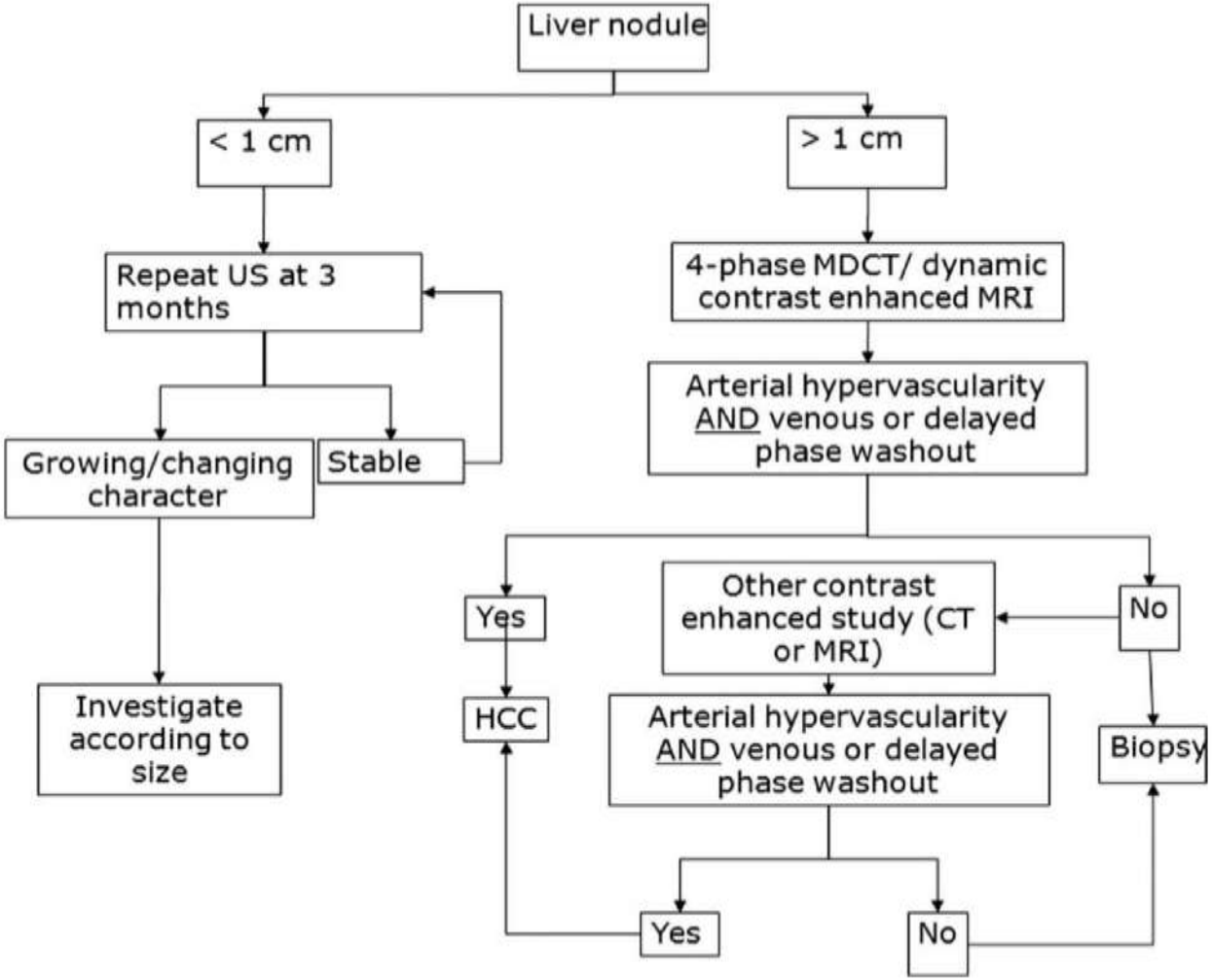
- Increased enhancement on arterial phase
- Decreased enhancement (Washout) on delayed or equilibrium phase



Arterial Phase **Portal Phase** **Delayed Phase**



AASLD 2010 Update



- **Typical pattern(<2cm)**

→ **61.7% sensitivity**

96.6% specificity

- **HCC washout**

→ **< 1 cm: 27%**

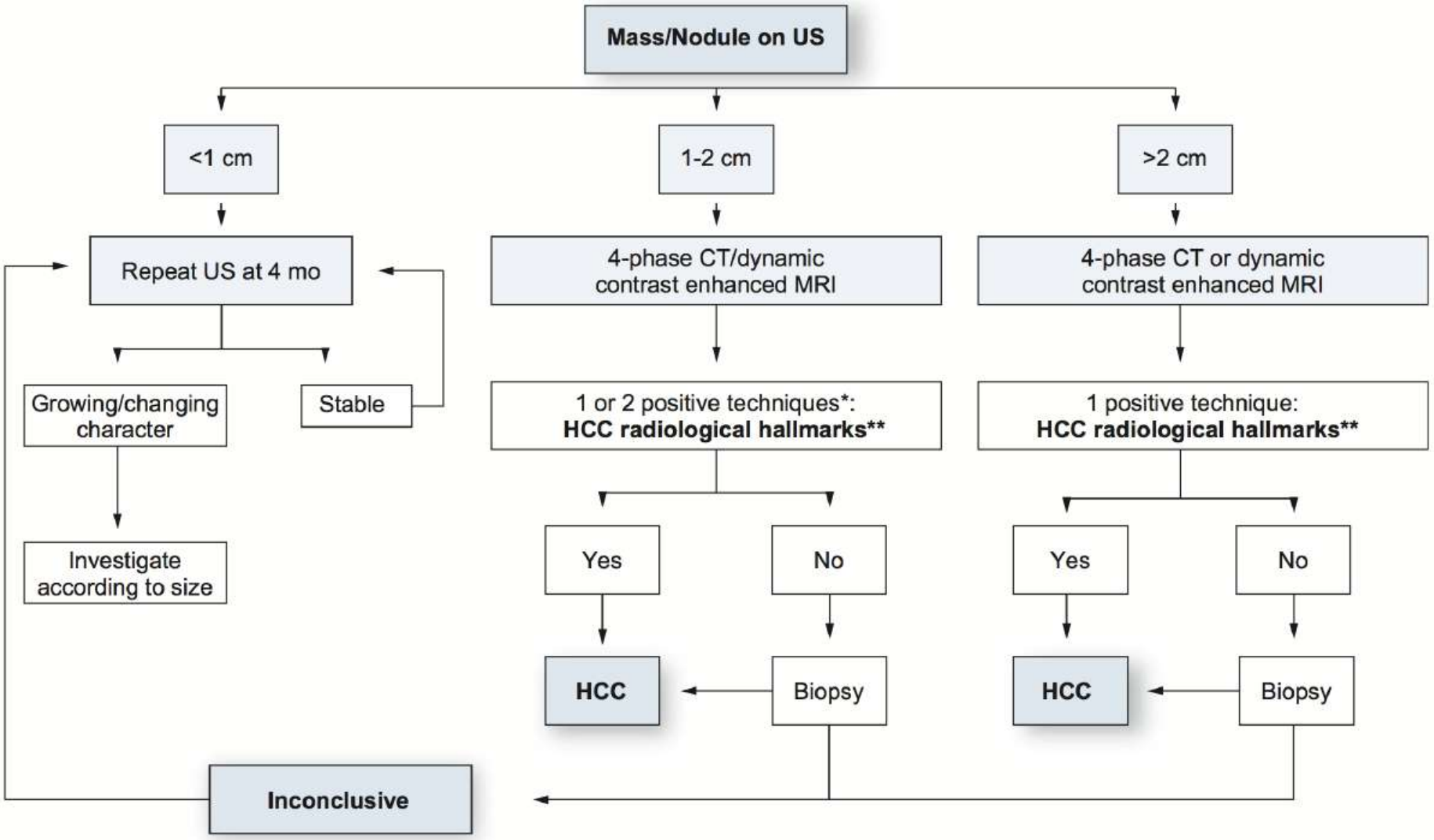
>1, <1.5 cm: 39%

>1.5,<2 cm: 50%

>2cm: 82%

Bruix, Hepatology 2011
Forner, Hepatology 2008
Bruix and Sherman. Hepatology 2011

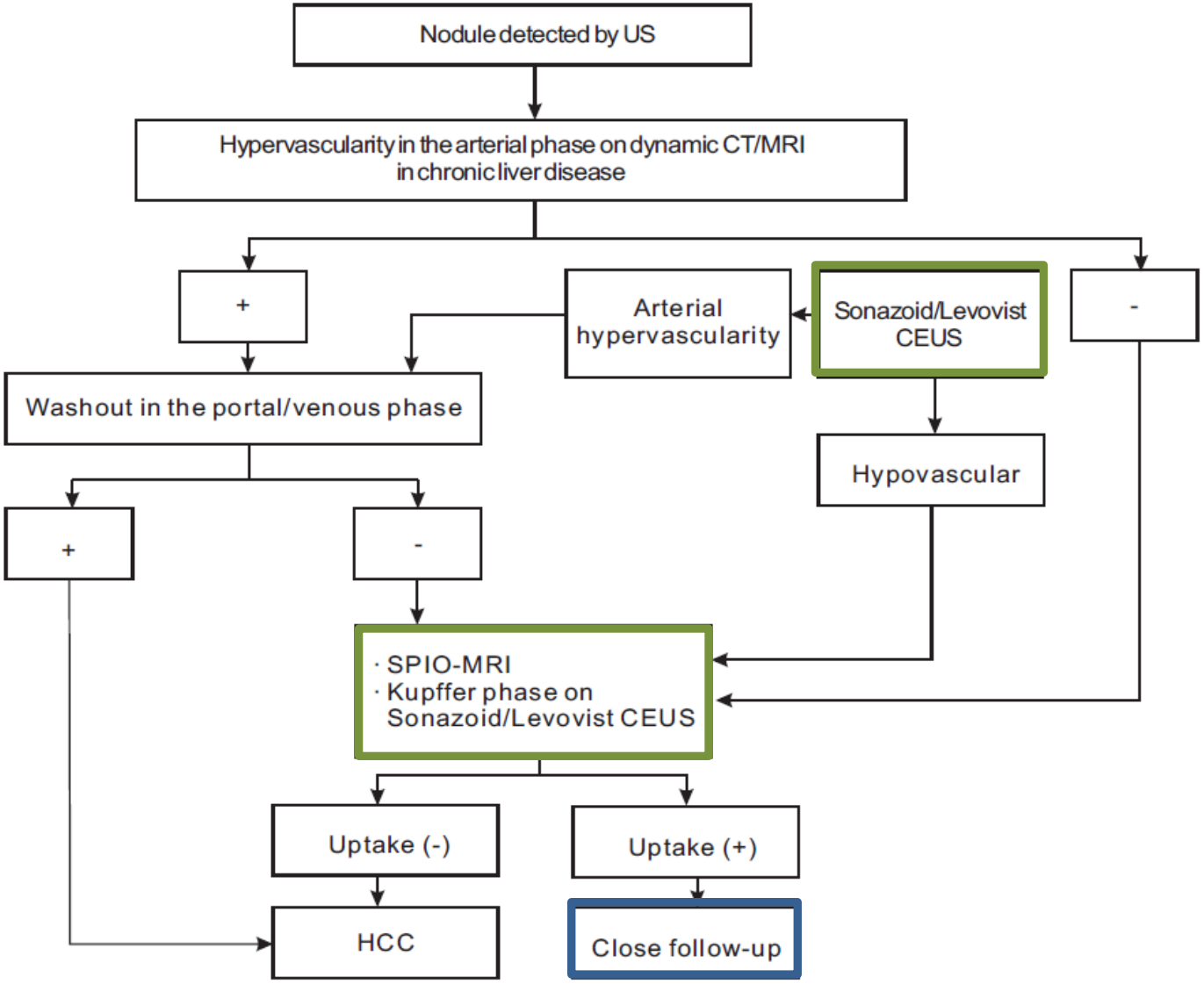
EASL-EORTC 2011



EASL-EORTC clinical practice guidelines. J Hepatol 2012

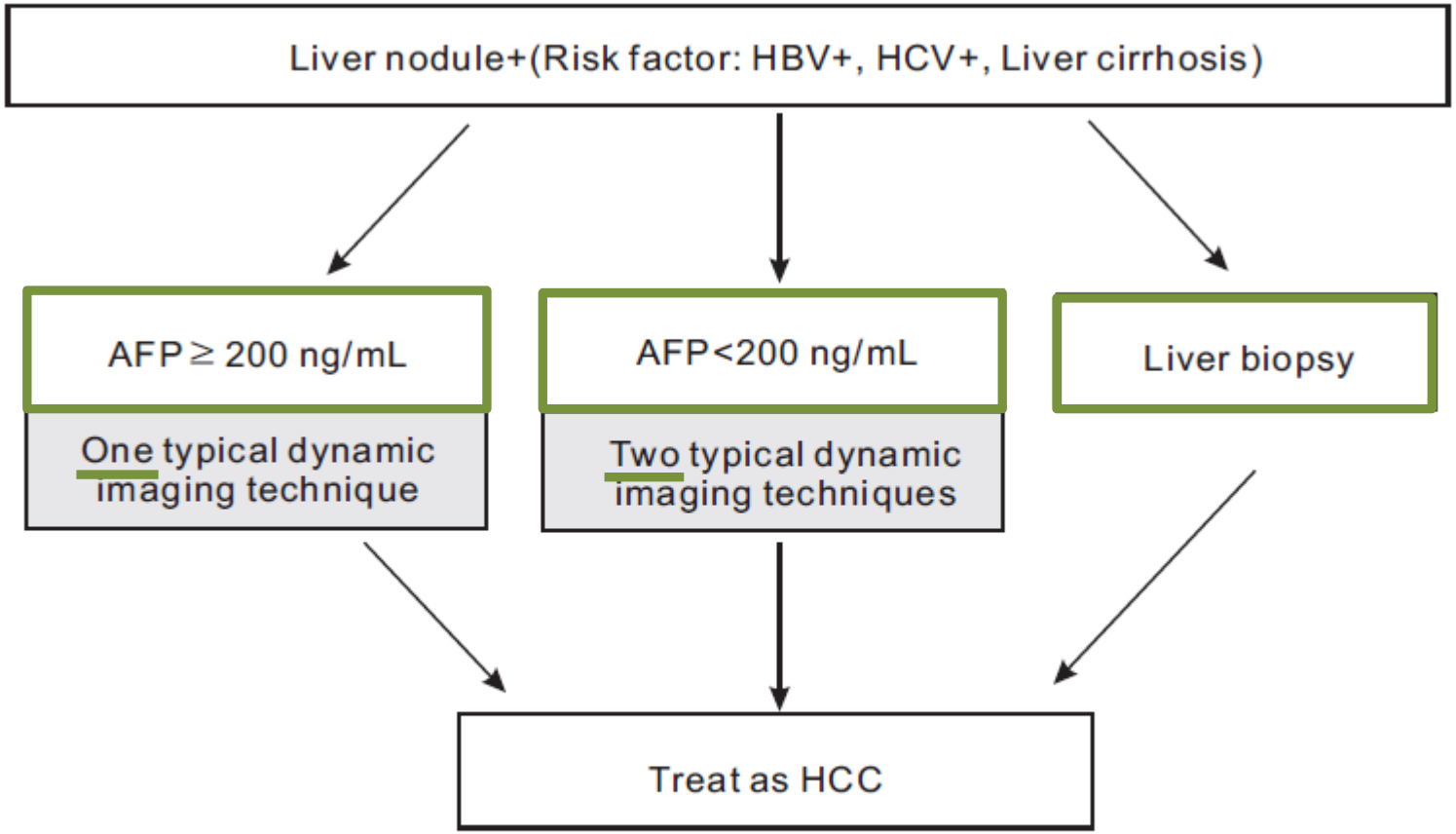
APASL guideline in 2010

(Asian Pacific Association for the Study of the Liver)



KLCSG guideline in 2009

(Korean Liver Cancer Study Group)



If liver cirrhosis patients have a tumor ≥ 2 cm, typical characteristic finding of HCC in either one of dynamic contrast enhancement CT or MRI, regardless of serum AFP level

Discordance among the guidelines

- Nodules <1cm showing typical CE pattern
  - AASLD, EASL: US F/U
  - APASL, JSH: regardless of size

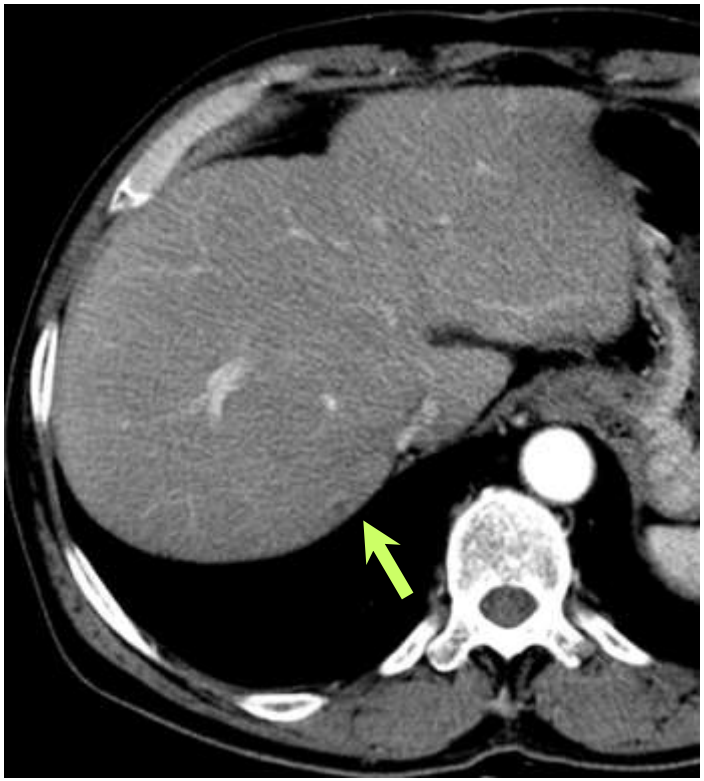
- Hypervascularity
  - AASLD, EASL, Korean : CT, MRI
  - APASL, JSH: + CEUS (CTAP)

Discordance among the guidelines

- Hypervascular nodule /s WO
  - AASLD, EASL : Bx
  - APASL, JSH: further evaluation with CEUS, SPIO-MRI or EOB-MRI
    - some ICC, adenoma, FNH-like nodule

- Hypovascular nodule
  - AASLD, EASL, Korean: US F/U
  - APASL: defect on SPIO-MRI or CEUS → HCC
    - HGDN
  - JSH : defect on EOB-MRI & CEUS →HCC, one of them →Bx

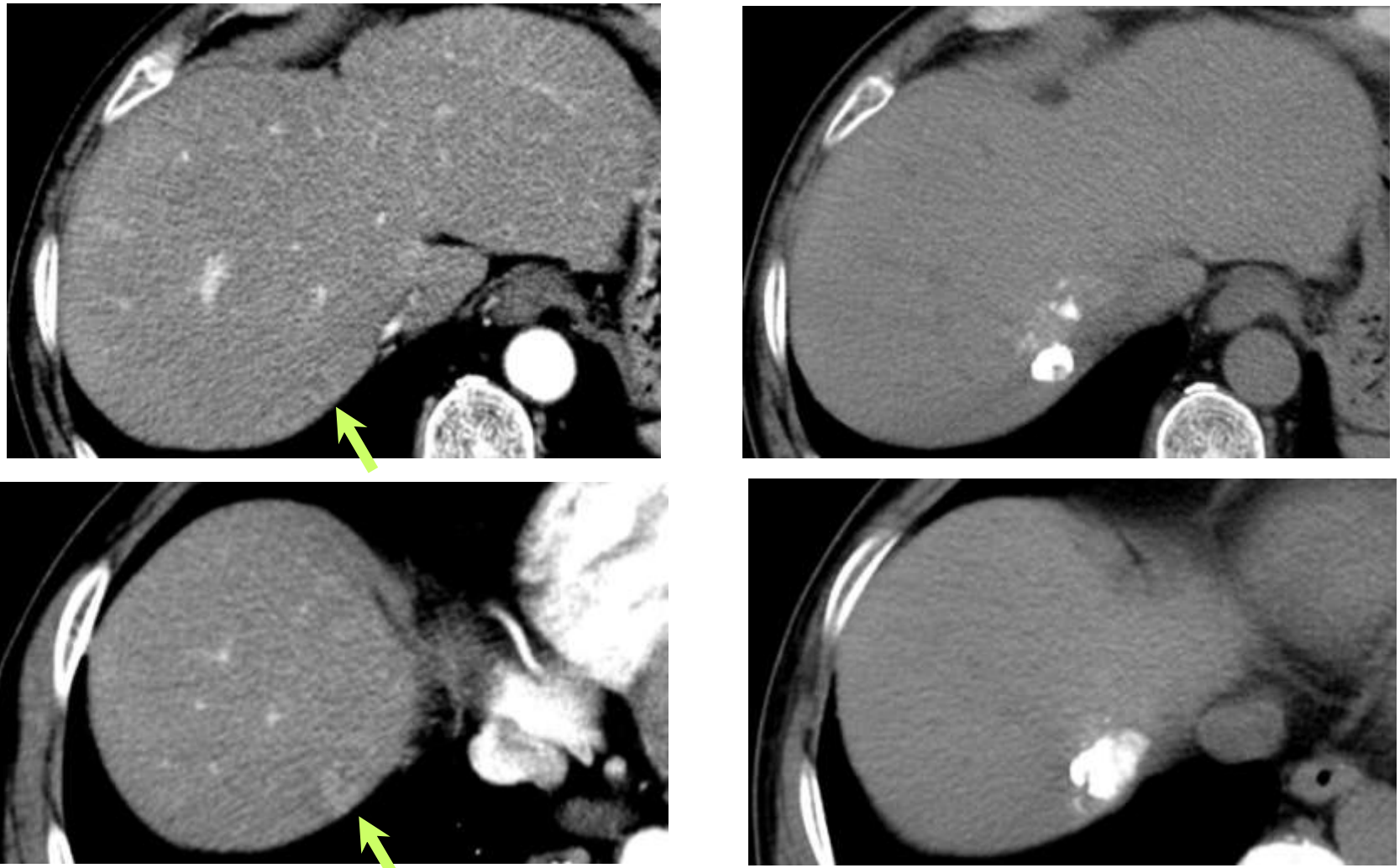
Nodule (<1cm)
showing hypervascularity /s WO



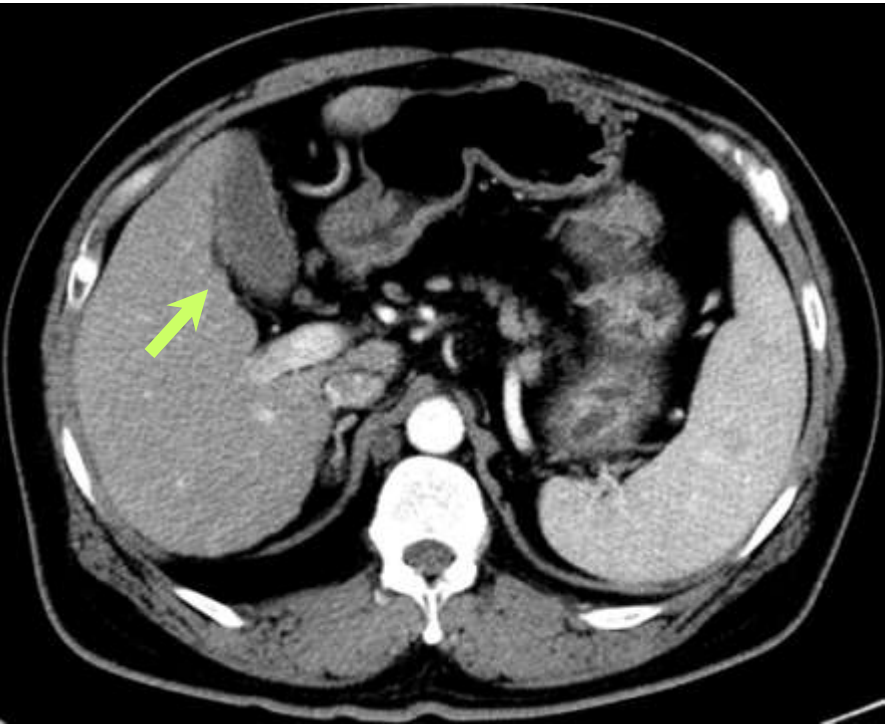
AP

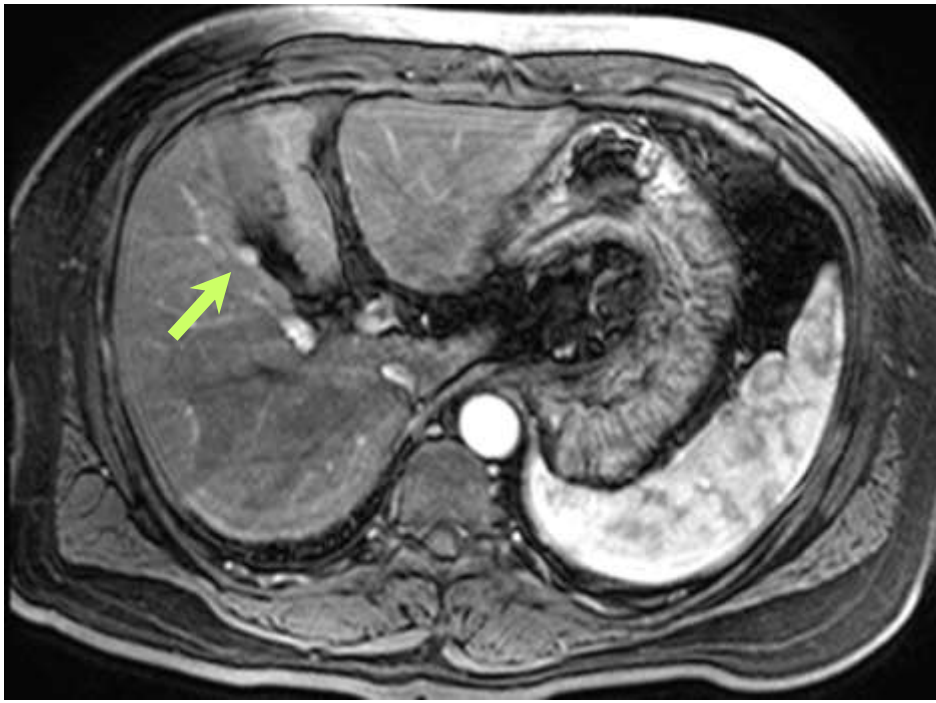
EP

→14m later, Dx of HCC & TACE



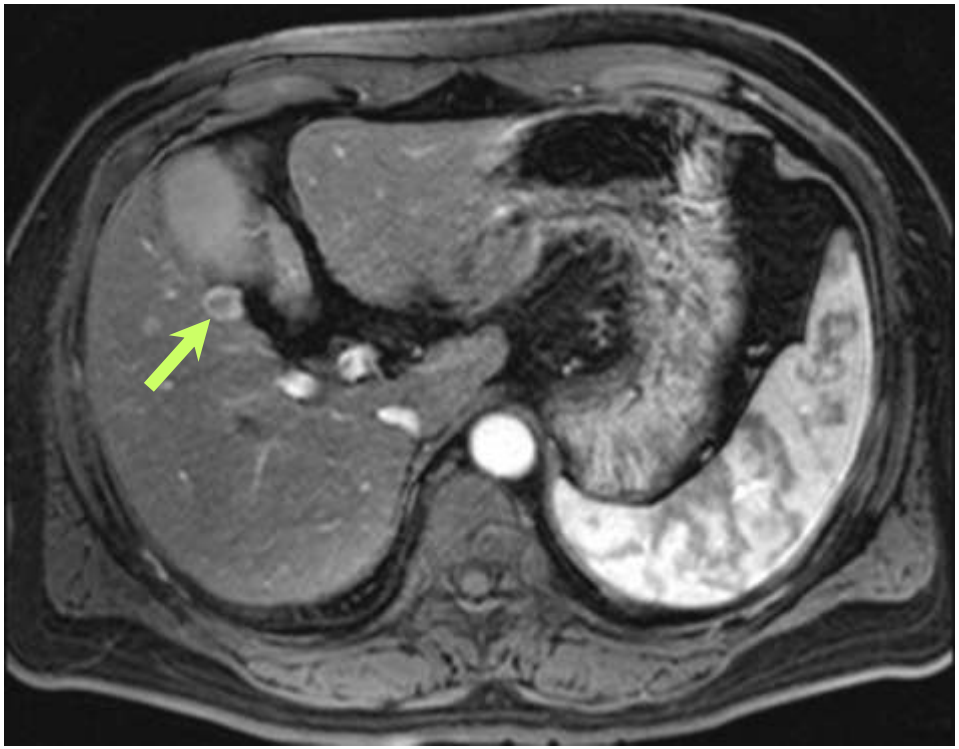
Nodule (<1cm) showing hypervascularity /s WO

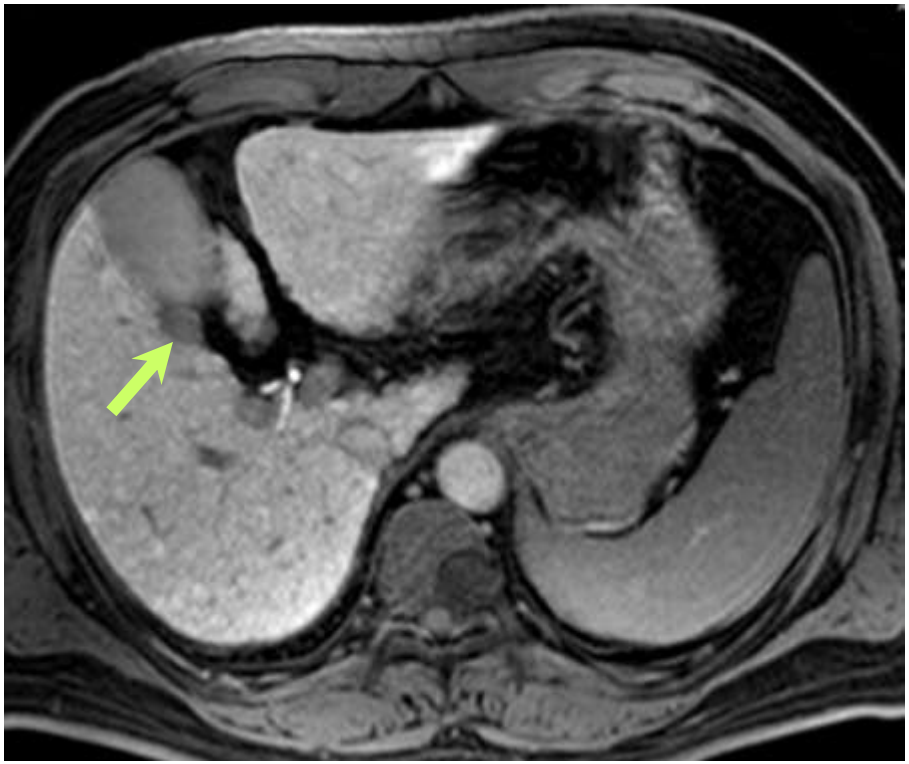




AP → 4m later AP

→12m later,
HCC with microvascular invasion





Hypervascular Small HCC (≤ 1cm) on Gd-EOB-DTPA MRI & DWI

TABLE 3: Results of Multivariate Analysis for Diagnosis of Hepatocellular Carcinoma 1 cm and Smaller

MRI Finding	Odds Ratio	95% CI	*p*
Hyperintensity on T2-weighted images	16.1	4.7–55.1	< 0.0001
Hyperintensity on diffusion-weighted images	5.7	1.6–20.5	0.0081
Hypointensity on hepatobiliary phase images	3.4	0.8–14.7	0.7537
Washout on portal venous or 3-minute late phase images	0.8	0.2–3.4	0.1063

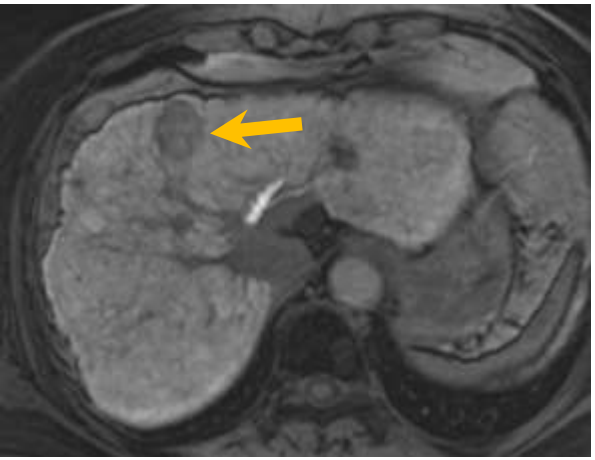
TABLE 4: Sensitivity and Specificity for Diagnosis of Hepatocellular Carcinoma Measuring 1 cm or Smaller

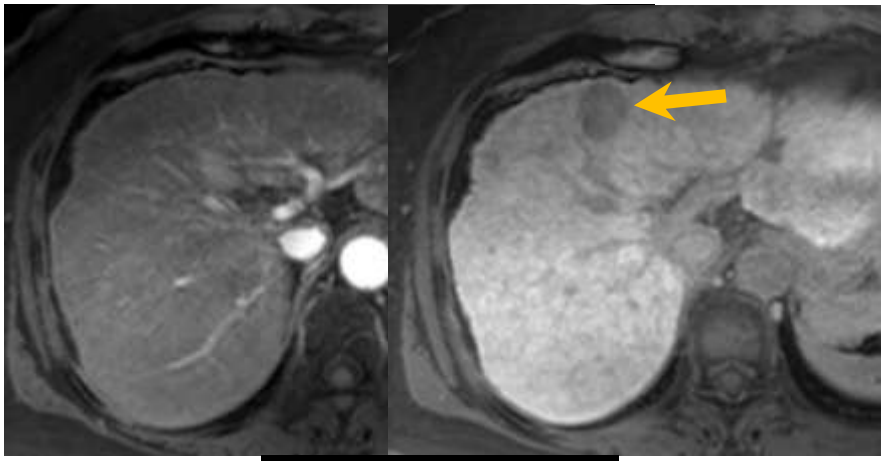
MRI Finding	Sensitivity (%)	95% CI	Specificity (%)	95% CI
Hyperintensity on T2-weighted images	90.7	80.3–95.9	78.8	55.1–91.8
Hyperintensity on diffusion-weighted images	73.2	60.3–83.0	84.9	61.7–95.1
Hyperintensity on T2-weighted images and diffusion-weighted images	67.6	54.5–78.4	87.9	65.2–96.6

Kim J, Kim SH. AJR 2011;196:W758

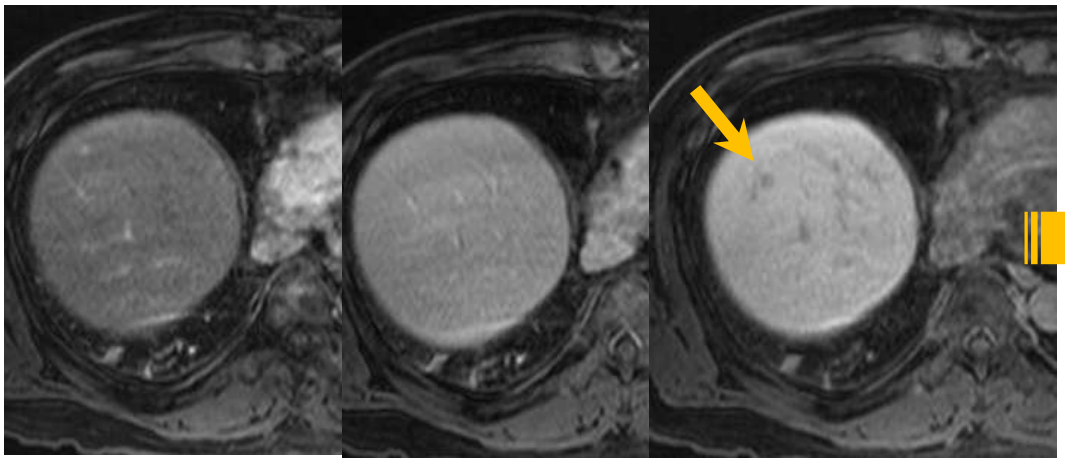
Hypovascular HCC

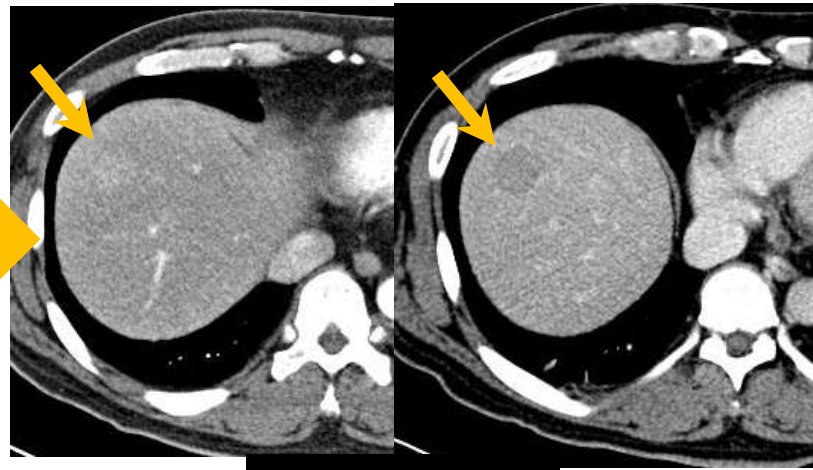
-On EOB-MRI, hypovascular hypointense nodule on HBP





32 m later





8 m later

Hypovascular HCC

- Among hypovascular hypointense nodule on HBP of EOB-MRI,

  → Recognition of HCC or high risk nodule

  – Size ≥ 15mm

  – Hyperintensity on DWI

Kumada T et al. AJR 2011;197:58

Kim YK et al. Radiology 2012;265(1):104

  – Hyperintensity on T2WI, growth rate

Hyodo T et al. Radiology 2013;266(2):480

  – Fat within nodule, Hyperintensity on T1WI, growth rate

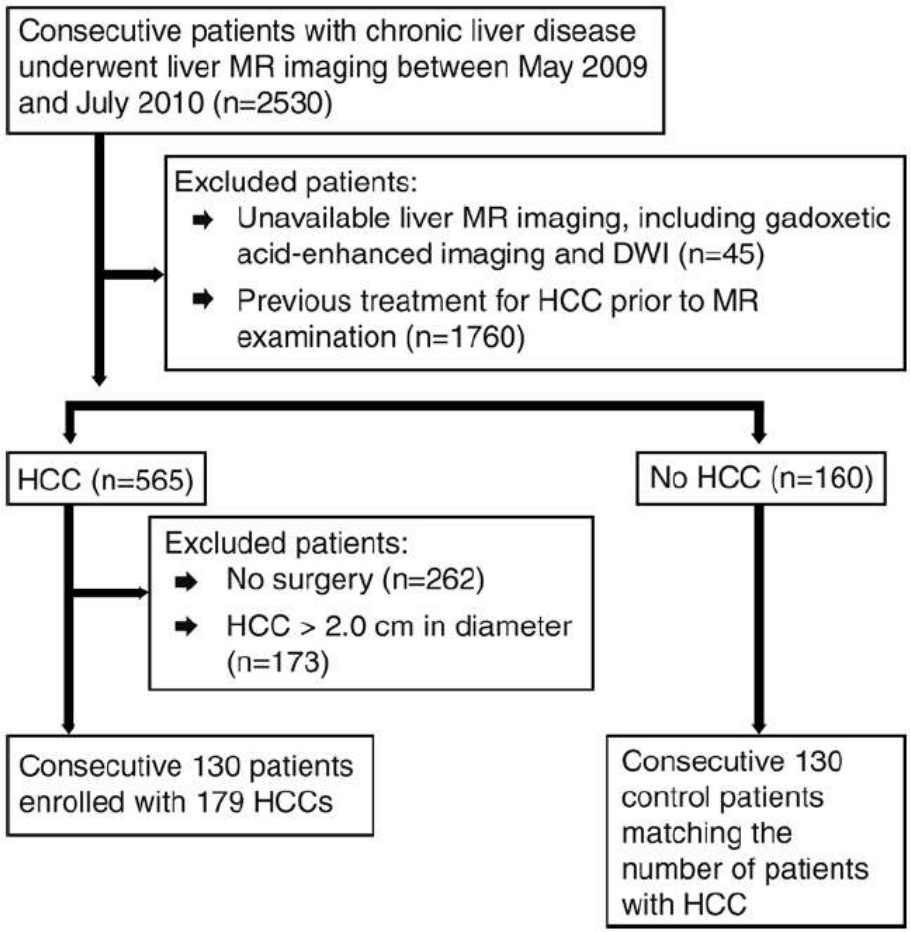
Higaki A et al. JMRI 2013;37:1377

For early diagnosis of HCC

- Higher sensitivity using combination of contrast-enhanced MRI and DWI

Small Hepatocellular Carcinomas: Improved Sensitivity by Combining Gadoxetic Acid–enhanced and Diffusion-weighted MR Imaging Patterns[1]

Park MJ, Kim YK et al.
Radiology 2012;264(3):761



- <Dx criteria for HCC>

① Gadoxetic acid set :

a. hypervascularity + WO + HBP low SI

② DWI set :

DWI high SI + ADC value ≤ that of parenchyma

③ Combined set:

a. hypervascularity + WO + HBP low SI

a. hypervascularity + HBP iso- or low SI + DWI high SI

faint or no a. hypervascularity + HBP low SI + DWI high SI

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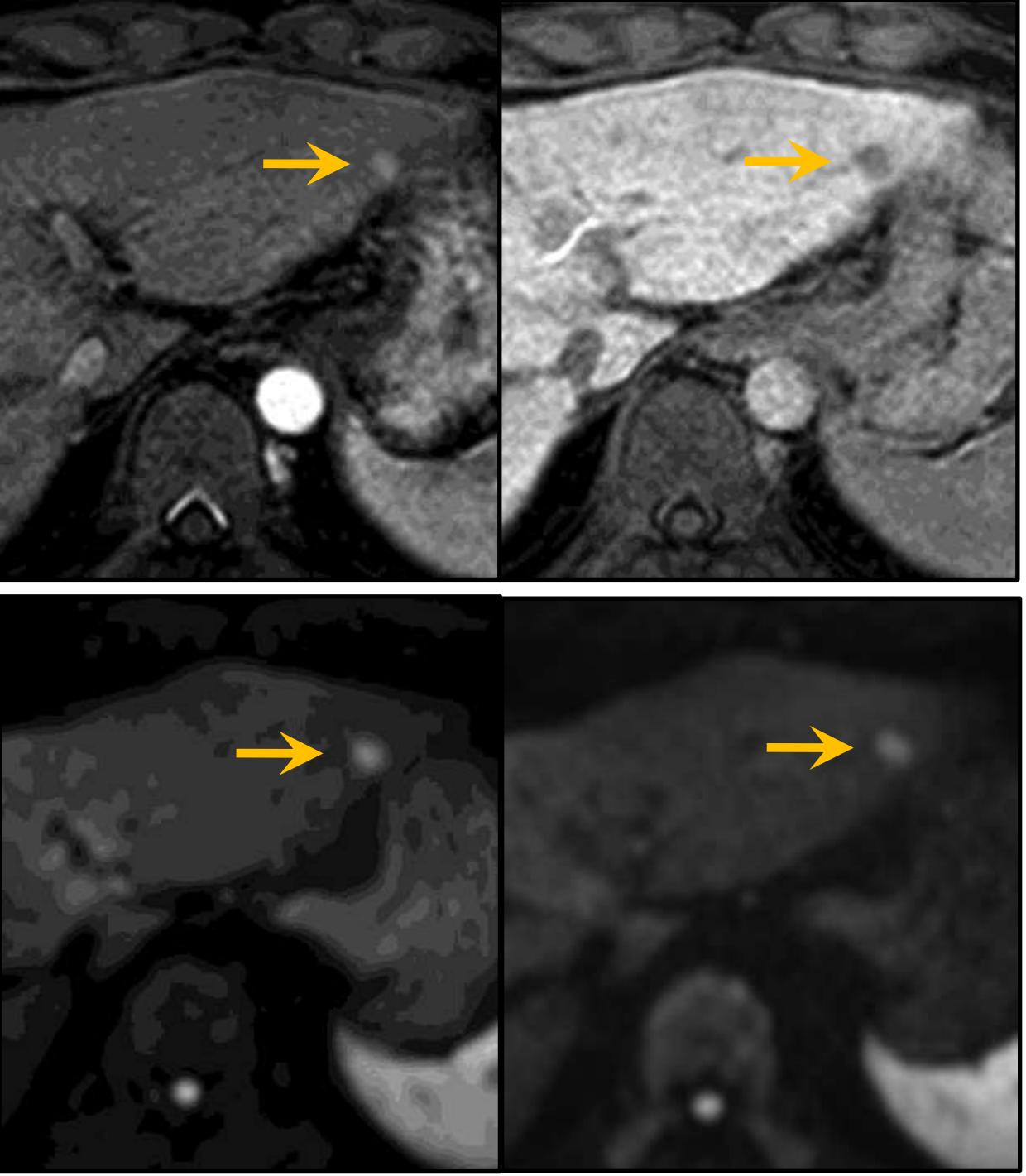
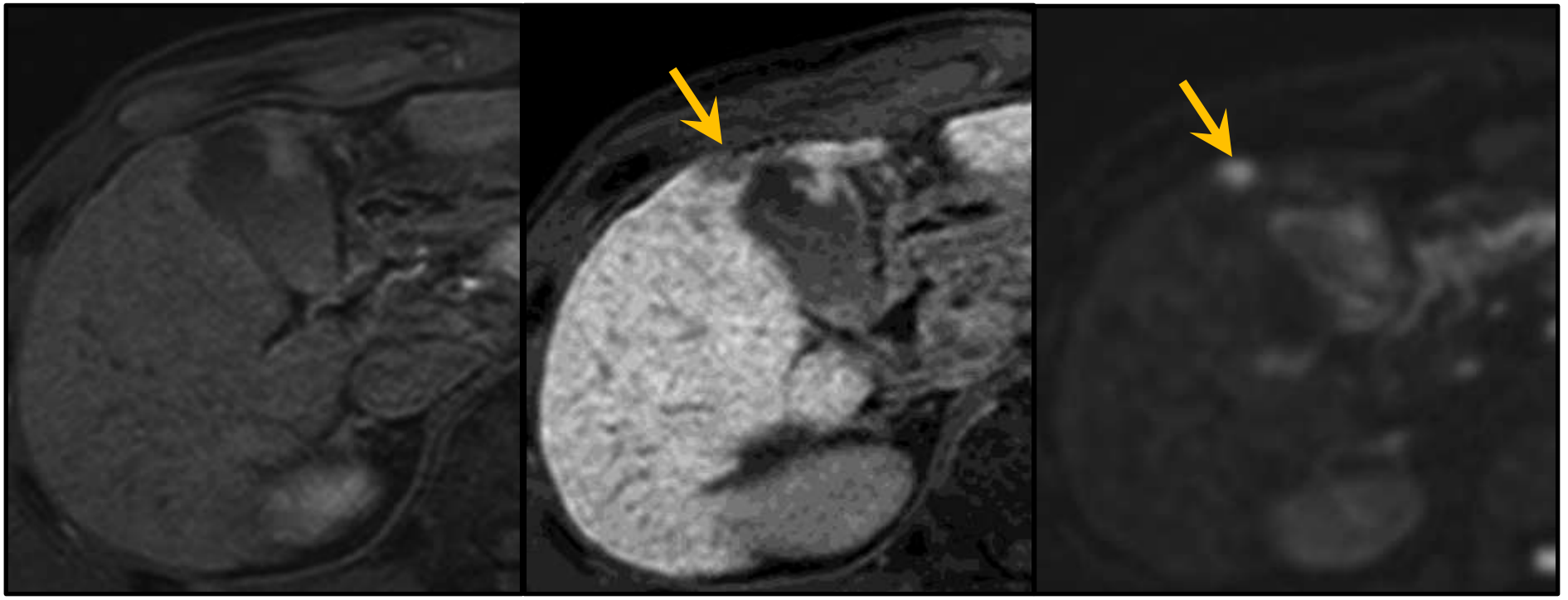


62/M,
HCC grade II

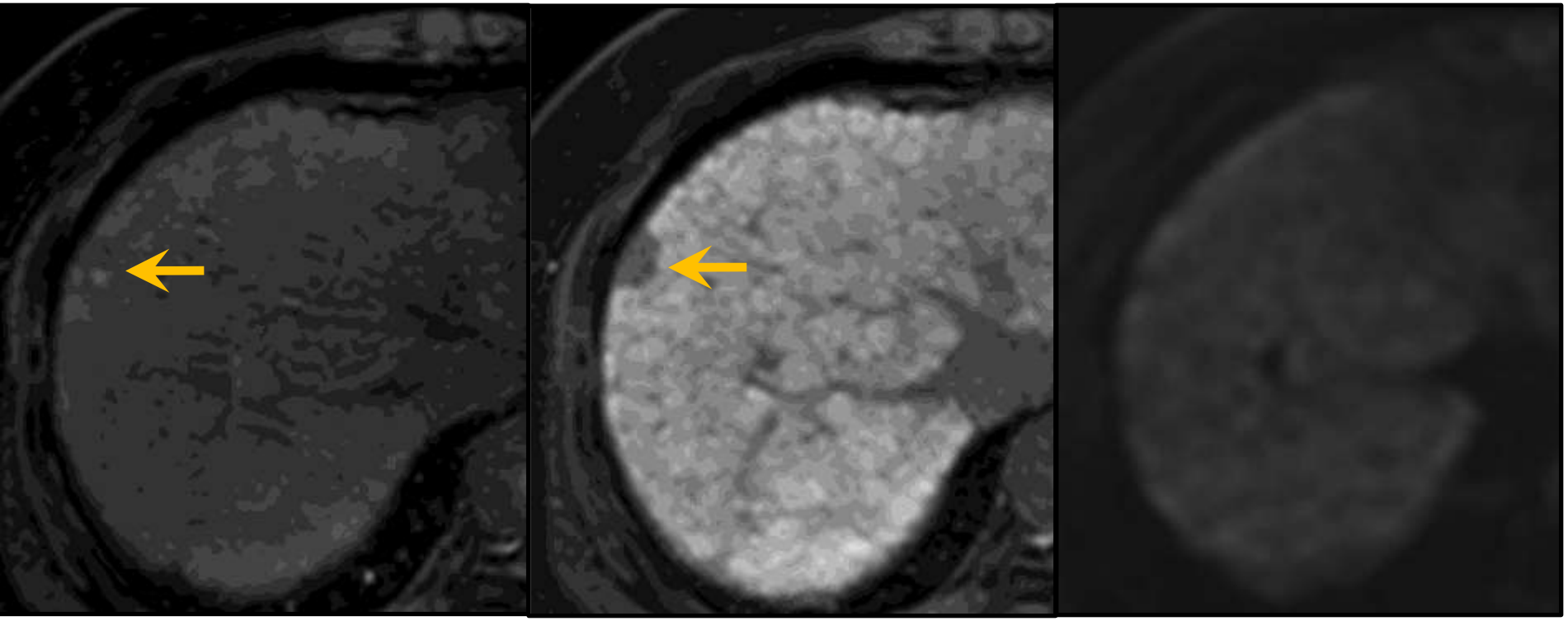
- **Gadoxetic acid set:**4
- **DWI set:** 4
- **Combined set:** 4

66/M, HCC grade I



- **Gadoxetic acid set:** 1
- **DWI set:** 3 or 4
- **Combined set:** 3

55/M, HCC grade I > II



- **Gadoxetic acid set:** 3
- **DWI set:** 1
- **Combined set:** 3

Sensitivity and Positive Predictive Values for the Detection of 179 HCCs

Lesion Group and Imaging Modality	Observer 1		Observer 2		Observer 3		Pooled Data	
	Sensitivity*	PPV†	Sensitivity*	PPV†	Sensitivity*	PPV†	Sensitivity*	PPV†
All lesions (n = 179)								
Gadoxetic acid set	81.0 (145)	98.6 (2)	82.1 (147)	98.7 (2)	80.5 (144)	98.0 [3]	81.4 (437)‡	98.4 [7]
DW imaging set	79.9 (143)	96.6 (5)	77.7 (139)	97.2 (4)	78.8 (141)	96.6 [5]	78.8 (423)‡	96.8 [14]
Combined set	92.7 (166)§	98.2 (3)	91.1 (163)§	98.2 (3)	93.3 (167)§	97.1 [5]	92.4 (496)‡	97.8 [11]
Lesions ≤1.0 cm (n = 55)								
Gadoxetic acid set	58.2 (32)	94.1 (2)	61.8 (34)	94.4 (2)	56.4 (31)	93.9 [2]	58.8 (97)	94.2 [6]
DW imaging set	63.6 (35)	87.5 (5)	56.4 (31)	88.6 [4]	60.0 (33)	89.2 [4]	60.0 (99)	88.4 [13]
Combined set	85.5 (47)§	94.0 (3)	81.8 (45)§	93.8 [3]	87.3 (48)§	92.3 [4]	84.8 (140)§	93.3 [10]
Lesions >1.0 cm (n = 124)								
Gadoxetic acid set	91.13 (113)	100 (0)	91.13 (113)	100 [0]	91.13 (113)	99.1 [1]	91.1 (339)‡	99.7 [1]
DW imaging set	87.1 (108)‖	100 (0)	87.1 (108)‖	100 [0]	87.1 (108)‖	99.1 [1]	87.1 (324)‡	99.7 [1]
Combined set	96.0 (119)‖	100 (0)	95.2 (118)‖	100 [0]	96.0 (119)‖	99.2 [1]	95.7 (356)‡	99.7 [1]

- The combination of gadoxetic acid–enhanced MRI and DWI yielded better sensitivity in the detection of small HCCs than each MR imaging technique alone.

Park MJ, Kim YK et al. Radiology 2012;264(3):761

Conclusions

- Increased detection of small HCC due to advanced imagaing
- More studies necessary for indeterminate liver nodule
- Guidelines for HCC diagnosis; HBP (and DWI) MRI