Is ultrasonography enough?
Alternative imaging techniques for the surveillance of HCC

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Learning objectives

To learn the feasibility, diagnostic performance, strength and weakness of alternative imaging techniques other than ultrasonography (US) for surveillance of hepatocellular carcinoma (HCC) in high risk patients

Why we perform USG for HCC surveillance?

HCC: Good candidate for surveillance

- Clear target population: Cirrhosis, Hepatitis B, Hepatitis C with fibrosis…
- Detecting early stage HCC can offer advantages to patients
  - Multiple treatment options

US: a good surveillance tool for HCC

- Relatively cheap, widely available, good compliance, no radiation, no invasiveness
- Acceptable diagnostic performance: sensitivity, specificity

US is considered as a standard surveillance tool for HCC in most countries

- Korea (KLCS-NCC), Japan (JSH), Asia (APASL), the USA (AASLD), Europe (EASL-EORTC), Ultrasound LI-RADS

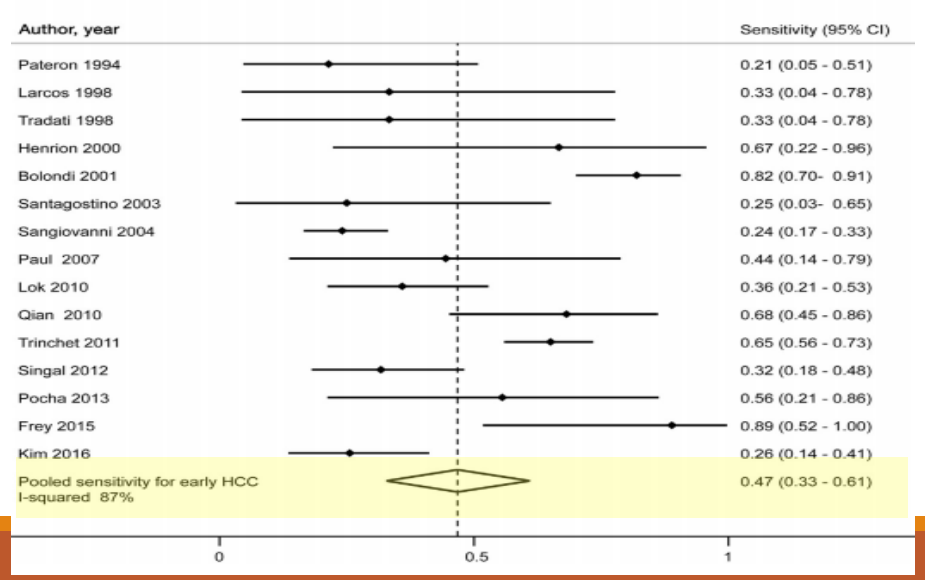
Bruix J. Hepatology 2011
EASL. J Hepatol 2012
Korean Liver Cancer Study Group. Korean J Radiol 2014
Kudo M. Oncology 2014

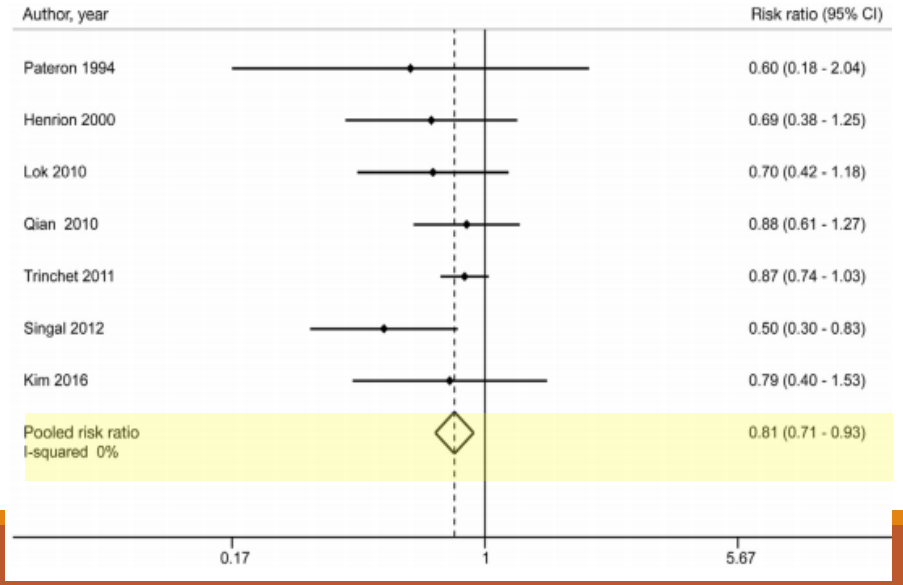
BACKGROUND

Limitation of USG for HCC surveillance

- Marked improvement in USG sensitivity over time :

- However, variety studies highlights **suboptimal sensitivity of USG** for **detection early HCCs**.
  - USG detected any stage HCC with 84% sensitivity but early-stage HCC with only **47%** sensitivity.
  - Ultrasound with vs. without AFP detected early-stage HCC with **63%** and **45%** sensitivity, respectively.

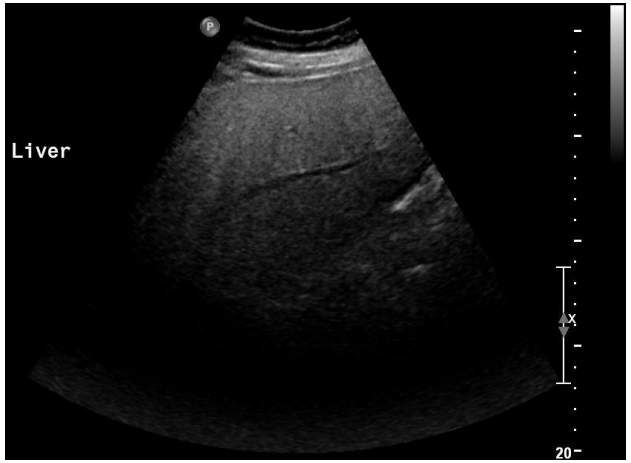


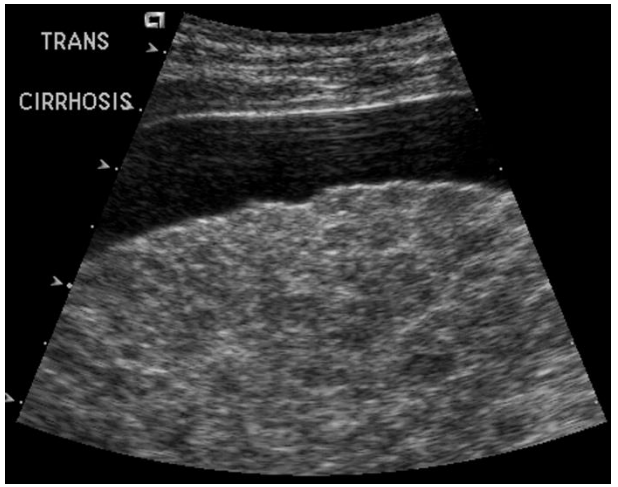


Tzartzeva K, et al. Surveillance Imaging and Alpha Fetoprotein for Early Detection of Hepatocellular Carcinoma in Patients with Cirrhosis : A Meta-analysis ; Gastroenterology 2018.

Why low sensitivity?

Operator dependent
- Quality issues



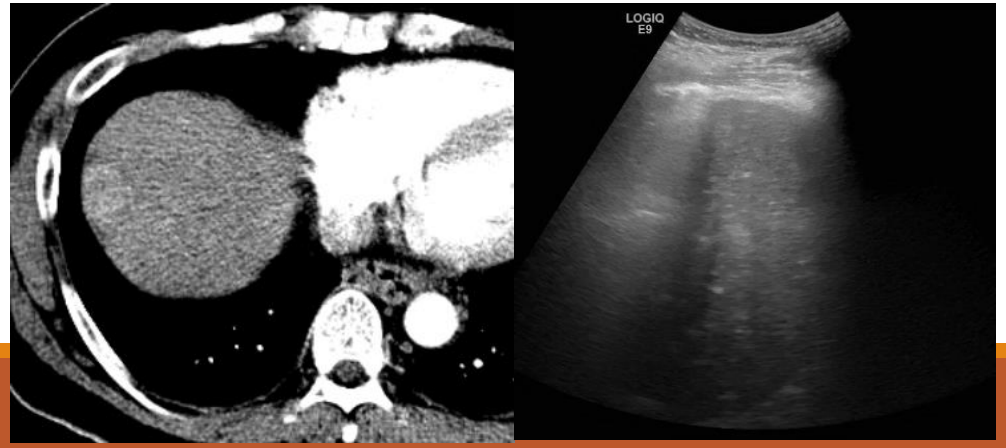


Obesity, fatty liver, bowel gas

Advanced cirrhosis
- **Poor sonic window**
- **too many nodules**

Infiltrative tumors

Difficult areas for US: Hepatic dome, angle



Japanese consensus based guidelines

Table 2. Definition of populations at high risk for HCC

A. Super-high-risk population
1. Hepatitis B-related liver cirrhosis
2. Hepatitis C-related liver cirrhosis
B. High-risk population
1. Chronic hepatitis B
2. Chronic hepatitis C
3. Liver cirrhosis (causes other than HBV or HCV)

Table 4. Surveillance protocol for early detection of HCC

1. Super-high-risk patients
Every 3–4 months
Ultrasound examination
AFP/PIVKA-II/AFP-L3 measurements
Every 6–12 months
Dynamic CT or dynamic MRI/EOB-MRI
2. High-risk patients
Every 6 months
Ultrasound examination
AFP/PIVKA-II/AFP-L3 measurements
EOB-MRI = Ethoxybenzyl-MRI.

Kudo M. Oncology 2014

Cost-effectiveness by incidence

Higher HCC incidence can justify the expensive surveillance tools

TABLE III

Gains in Life Expectancy (LE) and Marginal Cost-effectiveness (CE) Ratios* (US $) of Screening for Hepatocellular Carcinoma for Different Case Scenarios

Parameter	Gain in LE (months)	CE Ratios*, $
Best Case Scenario		
HCC Incidence		
1.5%/yr	2.9	55,264
4%/yr	7	30,158
6%/yr	9.2	26,078
Patient's Age		
65	7	28,205
75	4.5	32,690
3-year Survival post HCC Resection		
50%	5.6	33,648
40%	3.5	46,109
Intermediate Case Scenario		

Sarasin FP. Am J Medicine 1996

Target population is heterogeneous

Hepatitis B **without cirrhosis**

- Asian males > 40 yo: 0.4-0.6%/year
- Asian females >50 yo: 0.3-0.6%/year

Cirrhosis

- Hepatitis B with cirrhosis: 3-5%/year
- Hepatitis C with cirrhosis: 2-7%/year
- Primary biliary cirrhosis: 2-3%/year

Bruix J. Hepatology 2011

Applying same surveillance strategy is inappropriate

If we can concentrate on population with higher risk of HCC, then…

- More expensive surveillance tests can be justified

How can we estimate the risk?

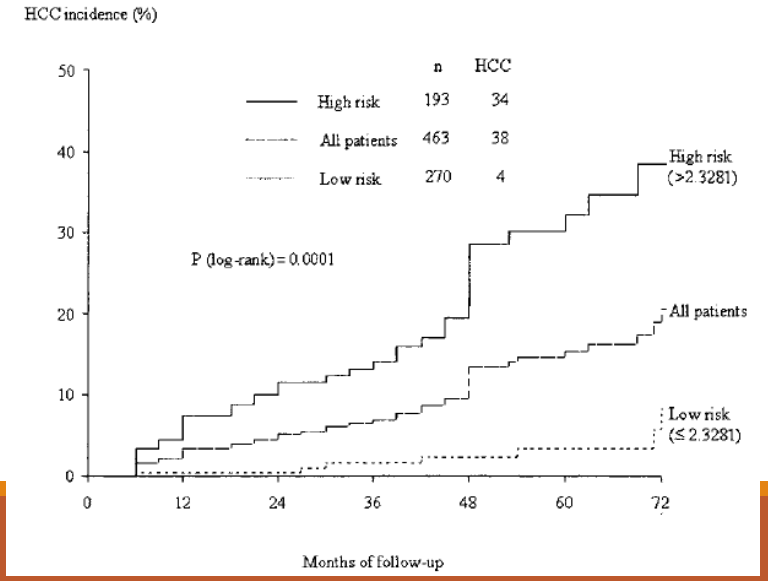
In patients with cirrhosis

Table 4. Variables With Independent Predictive Value for HCC in the Multivariate Analysis

Variables	Odds Ratio (95% Confidence Interval)	Coefficients	P
Prothrombin activity ≤75%	5.21 (1.8-14.9)	1.65	.002
Age 55 years or older	4.09 (1.8-9)	1.41	.005
Platelets $<75 \times 10^3/mm^3$	2.5 (1.3-4.9)	0.92	.007
Presence of anti-HCV antibodies	2.09 (1.1-4.2)	0.74	.03

Risk score > 2.33

- 4-year cumulative HCC incidence is 30%



Velzquez RF. Hepatology 2010

Alternative imaging tools for HCC surveillance

CEUS, Low dose CT, MRI (contrast enhanced, noncontrast)

These modalities should be test in surveillance setting

- "Results of the performance of these imaging modalities in diagnostic/staging setting come from biased populations" ***Bruix and Sherman. Hepatology 2011***

	Pros	Cons
CEUS	HCC hallmark No radiation	Expensive (similar to CT) Poor sonic window
Dynamic CT (low dose)	HCC hallmark	Expensive Radiation hazard Contrast reaction
Contrast enhanced MRI (Abbreviated)	HCC hallmark Very sensitive No radiation	(Very) expensive Contrast retention in tissue
Noncontrast MRI	No radiation Tissue contrast of MRI No contrast retention	Expensive no HCC hallmark

CEUS

Hepatology Research

Hepatology Research 2012; **42**: 376–384 doi: 10.1111/j.1872-034X.2011.00936.x

Original Article

Cost-effectiveness analysis on the surveillance for hepatocellular carcinoma in liver cirrhosis patients using contrast-enhanced ultrasonography

Hironori Tanaka,[1,2] Hiroko Iijima,[1,2] Kazuhiro Nouso,[3] Noriaki Aoki,[4] Takashi Iwai,[1] Tomoyuki Takashima,[1] Yoshiyuki Sakai,[1] Nobuhiro Aizawa,[1] Kazunari Iwata,[1] Naoto Ikeda,[1] Yoshinori Iwata,[1] Hirayuki Enomoto,[1] Masaki Saito,[1] Hiroyasu Imanishi[1] and Shuhei Nishiguchi[1]

Using Sonoazoid®

- Long Kupffer phase
  - Whole liver scan is feasible

CEUS surveillance can prolong the survival of LC patients

CEUS is cost-effective (<$50,000/QALY)

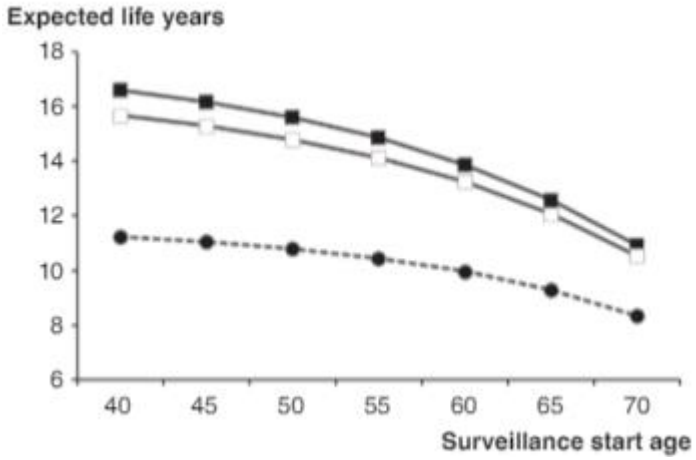


Table 2 Baseline analysis

Strategy	Total cost (US$)	Incremental cost (US$)	Expected life years (year)	QALY	Incremental QALY	IECR (US$/QALY)
No surveillance	29 142	–	10.45	6.18	–	–
US surveillance	58 064	28 922	14.13	7.85	1.67	17 296†
CEUS surveillance	65 726	36 584	14.86	8.17	1.99	18 384† (24 250‡)

Low dose liver CT

Low dose liver CT
- Low radiation dose (low kVp), less contrast agent
- Can obtund the shortcomings of CT surveillance

Patients with higher risk (risk index ≥ 2.33, that means the annual incidence of HCC more than 5%)
- 1 to 3 times LDCT and US (single arm, prospective study)
- LDCT: arterial and 3 min delayed (covering liver and spleen)

20 HCCs developed in 19 patients (19/98)
- Sensitivity: US 31.6%, LDCT 89.5% (p<0.001)
- Specificity: US 83.5%, LDCT 94.9%
- PPV: US 31.6%, LDCT 81.0% (p<0.001)

A Prospective Cohort Study to Compare Biannual Low Dose Liver CT and USG for HCC Surveillance in High-risk Group of HCC: Preliminary Study

Sunday 12:30-1:00 PM | GI322-SD-SUA5 | GI Community, Learning Center Station #5

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Disclosure: Nothing to Disclose
Joon Koo Han, MD Seoul, Korea, Republic Of
Disclosure: Nothing to Disclose

Yoon JH, Lee JM. SNUH. RSNA 2017

EOB MRI (full sequence)

JAMA Oncology | Original Investigation

MRI With Liver-Specific Contrast for Surveillance of Patients With Cirrhosis at High Risk of Hepatocellular Carcinoma

So Yeon Kim, MD, PhD; Jihyun An, MD; Young-Suk Lim, MD, PhD; Seungbong Han, PhD; Ji-Young Lee, BN; Jae Ho Byun, MD, PhD; Hyung Jin Won, MD, PhD; So Jung Lee, MD, PhD; Han Chu Lee, MD, PhD; Yung Sang Lee, MD, PhD

Biannual EOB-MRI (full sequences) vs. biannual US

Single arm, prospective study

407 patients with risk index ≥ 2.33

Kim SH, YS Lim, JAMA Oncol 2017

	US	EOB-MRI	P-values
Sensitivity for HCC (%)	27.9%	86.0%	<0.001
False positive rate (%)	5.6%	3.0%	0.004
Area under the curve	0.62	0.93	<0.001

Abbreviated MRI

Screening MRI performed in a shorter period time

- Decrease cost of MRI, competitive with US
- No radiation hazard

Two protocols suggested

- Dynamic imaging base (by UCSF group)
  - Using extracellular Gd contrast agent
  - LI-RADS categorization is feasible (radiological hallmark of HCC)
- T2WI or DWI and hepatobiliary phase (by New York and UCSD group)
  - Using gadoxetic acid
  - Gadoxetic acid is injected 20 min before patient entering MR room
  - LI-RADS categorization is not feasible

Besa C. Abdom Radiol 2016
Lee JY. Abd Radiol 2017
Marks RM. AJR 2015
Tillman BG. Clin Radiol 2018

Abdominal Radiology
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Abdom Radiol (2017)
DOI: 10.1007/s00261-017-1339-5

Dynamic imaging base

164 HCC screening MRI, retrospective, ECCM

Dynamic imaging only vs. full sequences

- Dynamic: pre-3 AP-PVP-DP
- Full sequences: Dynamic
- Three readers, LI-RADS s

Only 5% of LI-RADS categ

Intereader agreement wa

Evaluation of an abbreviated screening MRI protocol for patients at risk for hepatocellular carcinoma

Jennifer Y. Lee,[1] Eugene J. Huo,[1] Stefanie Weinstein,[1,4] Charmaine Santos,[4] Alexander Monto,[2,5] Carlos U. Corvera,[3] Judy Yee,[1,4] Thomas A. Hope[1,4]

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Table 2. LI-RADS scores based o
abbreviated MRI (aMRI) and the

	cMRI
LI-RADS 1	74 (47%)
LI-RADS 2	32 (21%)
LI-RADS 3	23 (15%)
LI-RADS 4	19 (12%)
LI-RADS 5	8 (5%)

Table 3. Inter-reader agreement (kappa) among the three readers for LI-RADS scores and major features for highest LI-RADS categorized lesion in 156 subjects for the abbreviated MRI (aMRI) and the complete MRI (cMRI)

	Reader 1	Reader 2	Reader 3	Agreement (κ)
aMRI				
LI-RADS 1/2	108	111	115	
LI-RADS 3	29	23	19	0.305
LI-RADS 4	11	13	8	
LI-RADS 5	8	9	14	
aMRI				
LR1/LR2	108	111	115	0.508
LR3/LR4/LR5	48	45	41	
cMRI				
LI-RADS 1/2	106	109	115	
LI-RADS 3	23	20	18	0.308
LI-RADS 4	19	17	9	
LI-RADS 5	8	10	14	
cMRI				
LR1/LR2	106	109	115	0.489
LR3/LR4/LR5	50	47	41	
Imaging features				
Arterial hyperenhancement	72	63	52	0.354
Washout appearance	15	23	18	0.355
Capsule appearance	14	5	15	0.416

HBP base

79 HCC surveillance MRI, retrospective, Gadoxetic acid

- Axial T2WI, axial SSFSE + HBP
- 27 HCCs in 13 patients

Interader agreement substantial (k = 0.75)

T1w HBP

T2w SSFSE	Hypo-intense	Iso-intense	Hyper-intense
Very hyper-intense	1	1	1
Mildly hyper-intense	4	3	3
Iso-intense	3	1	2
Mildly hypo-intense	3	2	2
Very hypointense	1	1	1

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journal homepage: www.clinicalradiologyonline.net

Diagnostic per-lesion performance of a simulated gadoxetate disodium-enhanced abbreviated MRI protocol for hepatocellular carcinoma screening

B.G. Tillman [a], J.D. Gorman [a], J.M. Hru [a], M.H. Lee [a], M.C. King [a], C.B. Sirlin [b], R.M. Marks [a,c,*]

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[c] Uniformed Services University of the Health Sciences, Department of Radiology and Radiological Sciences, Bethesda, MD, USA

Table 3
Per-lesion diagnostic performance of AMRI.

Statistic	Reader A	Reader B	Mean
Sensitivity	85.2 (23/27) [71.8–98.6%]	85.2 (23/27) [71.8–98.6%]	85.2 [72.8–93.3%]
PPV	85.2 (23/27) [71.8–98.6%]	71.9 (23/32) [56.3–87.5%]	78.0 [65.3–87.7%]
Accuracy	92.7 (102/110) [87.9–97.6%]	88.2 (97/110) [82.2–94.2%]	90.5 [85.8–94%]
NPV	95.2 (79/83) [90.6–99.8%]	94.9 (74/78) [90.0–99.8%]	95.0 [90.4–97.8%]

Data in parentheses are raw data, data in brackets are 95% confidence intervals.
NPV, negative predictive value; PPV, positive predictive value.

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DOI: 10.1007/s00261-016-0841-5

HBP base

174 MRIs, 80 HCCs in 62 patients, retrospective

AMRI: DWI + HBP

AMRI vs. full sequences including dynamic studies

Hep
per
pro
T1-
pos

Cecilia
Amita
Paolo

tic

Table 4. Per-lesion diagnostic sensitivity and PPV (mean and 95% CI) for HCC detection in 174 patients with 77 HCCs (pooled data between the 3 observers)

Imaging Criteria	Sensitivity	PPV
CE-set	84.0% (74.7–90.5%)	100% (96.9–100%)
DWI	81.8% (70.2–89.6%)	90.4% (83.1–94.8%)
T1w-HBP	87.9% (78.0–93.7%)	86% (77.9–91.5%)
Full AMRI*	77.9% (66.1–86.5%)	92.3% (85.1–96.2%)
P (CE-set vs. DWI)	0.59	**0.004**
P (CE-set vs. T1w-HBP)	0.3	**0.001**
P (CE-set vs. full AMRI)	0.14	**0.009**

represented in bold
according to AASLD 2011 criteria
and T2w (HASTE, and FSE T2w) sequences
tasets
T1w-HBP

Table 3. Per-patient diagnostic sensitivity, specificity, PPV, NPV, and accuracy for HCC detection for each observer and pooled data

	Imaging Criteria	Sensitivity	Specificity	PPV	NPV	Accuracy
Pooled data	CE-set	90.3% (81.2–95.3)	100% (94.1–100)	100% (88.6–100)	94.9% (89.7–97.6)	96.6% (93–98.3)
	DWI	85.5% (76.1–91.3)	94.9% (90.8–97.3)	90.3% (82.4–94.9)	92.2% (86.8–95.5)	91.6% (87.6–94.4)
	T1w-HBP	89.8% (80.8–94.8)	91.1% (86–94.4)	84.8% (76–90.7)	94.2% (88.6–97.1)	90.6% (86.3–93.7)
	Full AMRI*	80.6% (70.7–87.8)	96.1% (92.3–98.1)	92.0% (84.2–96.1)	90% (84–93.9)	90.6% (86.3–93.7)
	P (CE-set vs. DWI)	0.18	0.09	0.08	0.13	**0.006**
	P (CE-set vs. T1w-HBP)	0.9	**0.02**	**0.02**	0.73	**0.01**
	P (CE-set vs. full AMRI)	**0.03**	0.16	0.13	**0.02**	**0.003**

Table 5. Economic analysis to evaluate estimated cost savings for the AMRI protocol (full AMRI with contrast and unenhanced AMRI consisting of DWI + T2w + T1w in- and out-of-phase) using a range of estimated HCC prevalence

HCC prevalence	Cost full CE-MRI	Estimated cost full AMRI	Cost difference	Cost savings
2%	$527.8	$341.6	$186.1	35.3%
8%	$527.8	$365.9	$161.8	30.7%
HCC prevalence	**Cost full CE-MRI**	**Estimated cost unenhanced AMRI**	**Cost difference**	**Cost savings**
2%	$527.8	$268.7	$259.0	49.0%
8%	$527.8	$294.2	$233.6	44.2%

CATHOLIC UNIVERSITY OF KOREA

HBP base

298 surveillance MRI, retrospective

Set 1: T2 SSFSE + HBP, Set 2: T2 SSFSE + HPB + DWI

Good inter-observer and intra-observer agreement

Performance of Set1 and Set 2 was similar

TABLE 4: Comparison of Mean Per-Patient Diagnostic Performance of Image Set 1 and Image Set 2

Statistic	Difference in Mean Between Image Sets 1 and 2
Sensitivity	−1.0 (−5.8 to 0)
Specificity	0.0 (not applicable)
Accuracy	−0.1 (−0.7 to 0)
Positive predictive value	−0.3 (−1.5 to 0)
Negative predictive value	−0.2 (−1.1 to 0)

Note—Data are percentage (95% CI).

AJR 2015;204:527-535

Diagnostic Per-Patient Accuracy of an Abbreviated Hepatobiliary Phase Gadoxetic Acid–Enhanced MRI for Hepatocellular Carcinoma Surveillance

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Andrew Ryan[4,5]
Elhamy R. Heba[2]
An Tang[6]
Tanya J. Wolfson[7]
Anthony C. Gamst[7,8]
Claude B. Sirlin[2]
Mustafa R. Bashir[4]

OBJECTIVE. The purpose of this study is to evaluate the per-patient diagnostic performance of an abbreviated gadoxetic acid–enhanced MRI protocol for hepatocellular carcinoma (HCC) surveillance.

MATERIALS AND METHODS. A retrospective review identified 298 consecutive patients at risk for HCC enrolled in a gadoxetic acid–enhanced MRI-based HCC surveillance program. For each patient, the first gadoxetic acid–enhanced MRI was analyzed. To simulate an abbreviated protocol, two readers independently read two image sets per patient: set 1 consisted of T1-weighted 20-minute hepatobiliary phase and T2-weighted single-shot fast spin-echo (SSFSE) images; set 2 included diffusion-weighted imaging (DWI) and images from

TABLE 3: Per-Patient Diagnostic Performance of Abbreviated MRI

Statistic, Image Set	Reader A	Reader B	Mean [95% CI]
Sensitivity			
Set 1	85.7 (42/49) [72.8–94.1]	79.6 (39/49) [65.7–89.8]	82.6 [70.9–90.7]
Set 2	87.8 (43/49) [75.2–95.4]	79.6 (39/49) [65.7–89.8]	83.7 [71.7–90.9]
Specificity			
Set 1	91.2 (227/249) [86.9–94.4]	95.2 (237/249) [91.7–97.5]	93.2 [90.0–95.6]
Set 2	91.2 (227/249) [86.9–94.4]	95.2 (237/249) [91.7–97.5]	93.2 [90.0–95.6]
Accuracy			
Set 1	90.3 (269/298) [86.3–93.4]	92.6 (276/298) [89.0–95.3]	91.5 [88.3–94.2]
Set 2	90.6 (270/298) [86.7–93.7]	92.6 (276/298) [89.0–95.3]	91.6 [88.4–94.2]
Positive predictive value			
Set 1	65.6 (42/64) [52.7–77.1]	76.5 (39/51) [62.5–87.2]	71.0 [59.1–80.6]
Set 2	66.2 (43/65) [53.4–77.4]	76.5 (39/51) [62.5–87.2]	71.4 [59.5–80.8]
Negative predictive value			
Set 1	97.0 (227/234) [93.9–98.8]	96.0 (237/247) [92.7–98.0]	96.5 [93.1–98.2]
Set 2	97.4 (227/233) [94.5–99.0]	96.0 (237/247) [92.7–98.0]	96.7 [93.4–98.2]

Note—Except where noted otherwise, data are percentage (no./total) [95% CI].

Non-contrast MRI

T2WI, DWI (including ADC), T1 in- and opposed-phase

Lesions with T2 subtle high signal, diffusion restriction, fat as suspected HCC

Can reduce examination time (less than 10 min)

- Cost saving

No contrast injection

- Cost saving and no contrast deposition

No radiation hazard

Some preliminary studies show promising results

Kim YK. Magn Reson Imaging 2014
Han S. Korean J Radiol 2018
Whang SY. KCR, RSNA 2018

iMiS Company Co. Ltd 2017-0298 / ED / 4.24 (DH Kim)
Original Article | Gastrointestinal Imaging
pISSN 1229-6929 · eISSN 2005-8330
Korean J Radiol 2018;19(4):1-7
Check for updates
Korean Journal of Radiology KJR

Noncontrast MRI

175 HCC patients, initially diagnosed

174 control with chronic liver disease

T2 SSFSE, T2 FSE with fat sat, T1 in/opp, DWI

HCC favoring findings

- Intermediate high signal on T2
- Fat in T1 in/opp
- Diffusion resrtriction

The Diagnostic Performance of Liver MRIs without Intravenous Contrast for Detecting Hepatocellular Carcinoma: A Case-Controlled Feasibility Study

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Table 4. Per-Lesion Diagnostic Performance of Non-Contrast MRI

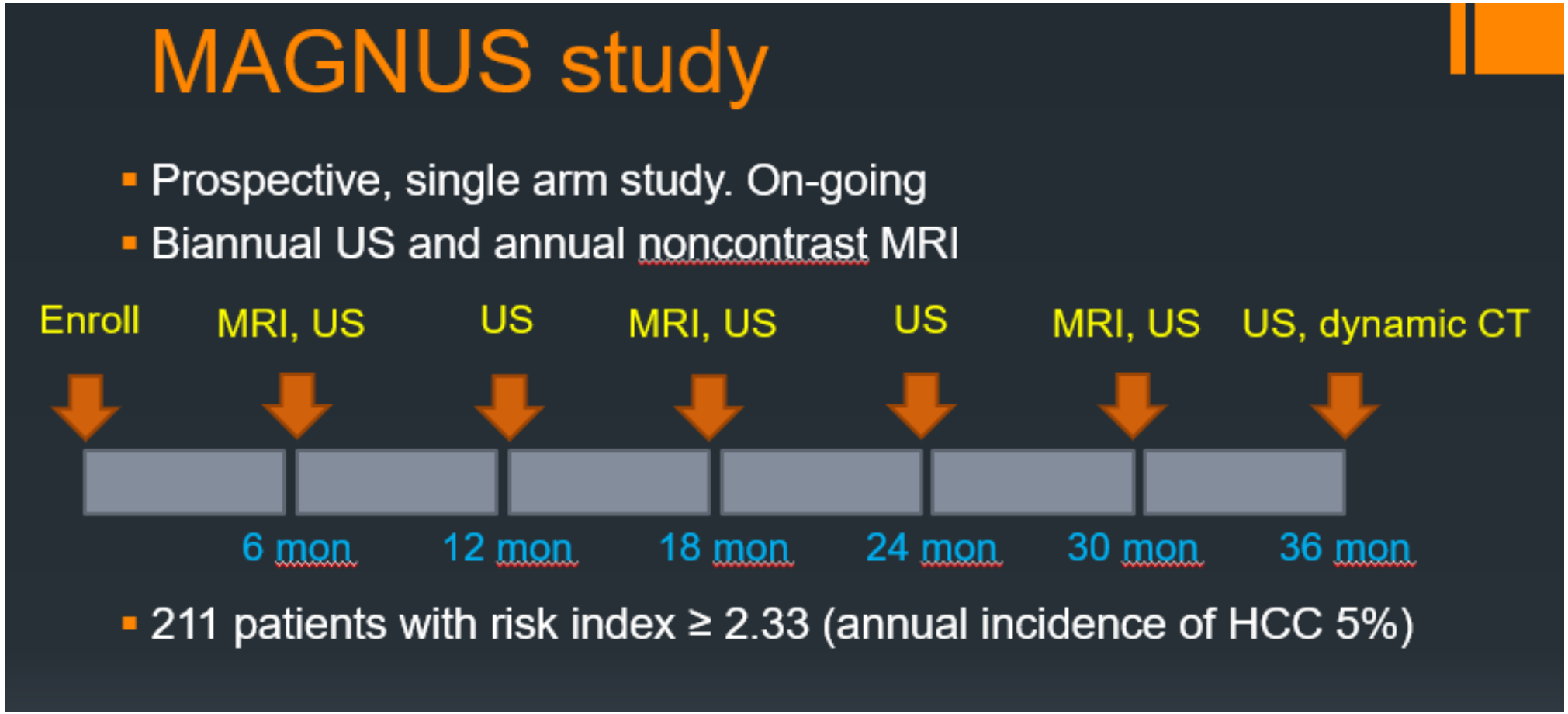
	Reader 1	Reader 2
Sensitivity (%), < 1 cm	36.8 (7/19)	47.4 (9/19)
Sensitivity (%), ≥ 1 cm, < 2 cm	68.6 (72/105)	60.0 (63/105)
Sensitivity (%), ≥ 2 cm	89.4 (101/113)	84.1 (95/113)
Sensitivity (%), all size	75.9 (180/237)	70.5 (167/237)

Table 3. Per-Patient Diagnostic Performance of Non-Contrast MRI

	Reader 1	Reader 2
For all HCCs (%)		
Sensitivity	86.3 (151/175, 95% CI = 80.3–91.0)	82.9 (145/175, 95% CI = 76.4–88.1)
Specificity	87.5 (63/72, 95% CI = 77.6–94.1)	76.4 (55/72, 95% CI = 64.9–85.6)
For HCCs ≥ 1 cm (%)		
Sensitivity	88.0 (147/167, 95% CI = 82.1–92.3)	86.2 (144/167, 95% CI = 80.1–91.1)
Specificity	87.5 (63/72, 95% CI = 77.6–94.1)	76.4 (55/72, 95% CI = 64.9–85.6)

CI = confidence interval, HCCs = hepatocellular carcinomas

Non-contrast MRI



MIRACLE-HCC

세브란스병원 SEVERANCE HOSPITAL

Non-contrast CT

Dual arm study, Each arm MRI or USG per 6 months

Proportion of early /very early stage is higher in MRI group (100%) than USG group (60%) (p= 0.029)

		USG group	MRI group	P-values
Staging at diagnosis	Very early	3	9	
	Early	3	3	
	Intermediate	1	0	
	Advanced	3	0	
	Total	10	12	
Detection rate	Very early	1.6% (3/189)	4.8% (9/188)	
	Very early or early	3.2% (6/189)	6.4% (12/188)	0.156
Surveillance failure rate		2.1% (4/189)	0% (0/172)	
False referral rate		3.4% (18/517)	0.4% (2/504)	<0.001

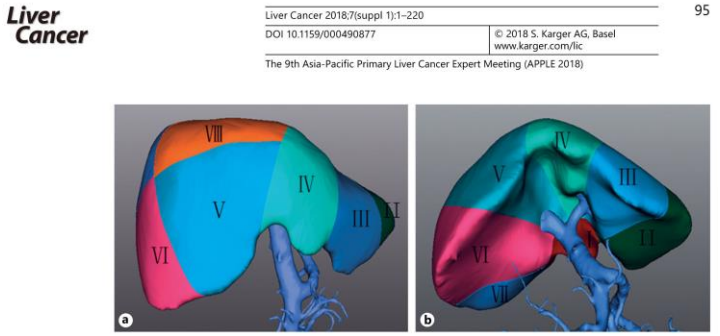


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Fig. 2. 3D visualization of Couinaud liver segmentation. **a** The diaphragm surface of liver. **b** The visceral surface of liver (for Abstract no PO-12).

PO-13

Unenhanced MRI versus Ultrasonography for Hepatocellular Carcinoma Surveillance: Preliminary Results of a Prospective Randomized Trial (MIRACLE-HCC)

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Aims: Guidelines recommend biannual ultrasonography (US) for hepatocellular carcinoma (HCC) surveillance in at-risk patients. However, there has been concern about the suboptimal performance of US. Our aim was to compare the performance of unenhanced magnetic resonance imaging (MRI) and US in the surveillance for HCC. **Methods:** For this prospective, non-blinded, balanced-randomized study (ClinicalTrials.gov identifier: NCT02514434), we have recruited patients with liver cirrhosis from a tertiary hospital in Korea. Patients were randomly assigned to biannual unenhanced MRI or US with alpha-fetoprotein (AFP) testing, for HCC surveillance. Our primary endpoints were detection rate of early-stage HCC, stage distribution at diagnosis, and false positive rate. Fisher's exact test was performed to compare the primary endpoints. **Results:** We performed a preliminary analysis of 377 patients who have received 1 to 6 examinations between May 2015 and March 2018. HCC incidence rate was 3.8% per year. In 188 patients in the MRI group (504 examinations), 12 (6.4% of patients) HCCs were detected at very early (n = 9) or early (n = 3) stage, with 2 (0.4% of exams) false referrals. In 189 patients in the US group (517 examinations), 10 (5.3% of patients) HCCs were detected at very early (n = 3), early (n = 3), intermediate (n = 1), or advanced stage (n = 3) with 18 (3.4% of exams) false referrals. The detection rate of very early or early HCC was higher in the MRI group without statistical significance (6.4% vs. 3.2%; $P = 0.156$). In the MRI group, the proportion of very early or early stage at diagnosis was higher (100% vs. 60%; $P = 0.029$), and the false positive rate was lower (0.4% vs. 3.4%; $P < 0.001$), compared to the US group. **Conclusions:** The preliminary results demonstrate that unenhanced MRI may be a promising tool for HCC surveillance. **Keywords:** Hepatocellular carcinoma, Surveillance, Magnetic resonance imaging, Ultrasound.

PO-14

Comparison of Risk Prediction Model for Hepatocellular Carcinoma in Patients with Hepatitis B Virus-Related Cirrhosis Receiving Antiviral Therapy

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Aims: Various models for the prediction of hepatocellular carcinoma (HCC) in the patients with chronic hepatitis B (CHB) were suggested. The aim of study is to identify if the HCC risk scores are improved as antiviral therapy is prolonged in the patients with CHB-related liver cirrhosis. **Methods:** The patients with CHB who received entecavir (ETV) or tenofovir (TDF) were investigated retrospectively. Patients with liver cirrhosis patients diagnosed by sonography, CT or biopsy were enrolled. We calculated the HCC risk scores at pre-antiviral therapy, and each year from year 1 to 5 of post-antiviral therapy. The models were GAG-HCC, CU-HCC, REACH-B, modified REACH-B

KARGER

Abbreviated MRI vs. Non-contrast MRI

Abbreviated MRI might have better diagnostic performance

Cost of noncontrast MRI is cheap

Is diagnostic performance of noncontrast MRI can be justified in the surveillance setting?

Comparison of Diagnostic Performance of Non-Contrast MRI and Abbreviated MRI in Initially Diagnosed Hepatocellular Carcinoma Patients

: A Simulation Study of Surveillance for Hepatocellular Carcinomas

Whang SY. KCR, RSNA 2018 presented

Sunyoung Whang, Junil Choi, Moon Hyung Choi, Sung Eun Rha, Young Jun Lee
Seoul St. Mary's Hospital
The Catholic University of Korea

2 Materials and Methods

Whang SY. KCR, RSNA 2018 presented

- **Image review**

: By **two radiologists**, independently (**location** and **size** of suspicious lesion)

Non-contrast MRI image set	**Abbreviated MRI image set**
1) T2w SSFSE 2) T2w FSE with fat saturation 3) DWI (b=500) and ADC map 4) **T1w IP/OPP** 5) **T1w 3D GRE**	1) T2w SSFSE 2) T2w FSE with fat saturation 3) DWI (b=500) and ADC map 4) **Hepatobiliary phase (20min delay)**
HCC favoring findings (*two out of three*)	
1) Subtle high SI on T2w 2) Diffusion restriction **3) Fat component in T1w IP/OPP**	1) Subtle high SI on T2w 2) Diffusion restriction **3) Signal defect on HBP**

3 Results

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Table 2. Comparison of Per-Patient Diagnostic Performance

Statistic, Image set	Reader 1	Reader 2
Sensitivity†		
Non-contrast MRI	89.4 (127/142) [83.2-94.0]	85.2 (121/142) [78.3-90.6]
Abbreviated MRI	88.0 (125/142) [89.4-97.3)	85.2 (121/142) [78.3-90.6]
	p = 0.64	p = 0.41
Specificity†		
Non-contrast MRI	93.7 (148/158) [88.7-96.9]	91.8 (145/158) [86.3-95.6]
Abbreviated MRI	94.3 (149/158) [89.5-97.3)	93.0 (147/158) [87.9-96.5]
	p = 0.87	p = 0.31
Accuracy†		
Non-contrast MRI	91.7 (275/300) [87.94-94.53]	88.7 (266/300) [84.52-92.02]
Abbreviated MRI	91.3 (274/300) [87.56-94.26]	89.3 (268/300) [85.28-92.59]
	p = 1.00	p = 0.20
Positive predictive value‡		
Non-contrast MRI	92.7 (127/137) [87.4-95.6)	90.3 (121/134) [84.6-94.0]
Abbreviated MRI	93.3 (125/134) [88.0-96.3]	91.7 (121/132) [86.1-95.13]
	p = 1.00	p = 0.83
Negative predictive value‡		
Non-contrast MRI	90.8 (148/163) [85.9-94.1]	87.4 (145/166) [82.3-91.1]
Abbreviated MRI	89.8 (149/166) [84.9-93.2]	87.5 (147/168) [82.5-91.2]
	p = 0.85	p = 1.00

† P-value of Mcnemar's test was corrected with Yates correction of 0.5.

‡ Fisher's exact test was performed on p-value.

No significant difference between two image sets

CATHOLIC UNIVERSITY OF KOREA

3 Results

Whang SY. KCR, RSNA 2018 presented

Table 3. Per-Tumor Diagnostic Sensivity for HCC Detection in 300 Patients with 177 HCCs

	Non-contrast MRI	Abbreviated MRI
Reader 1, n (%)		
Tumor < 2 cm	71/92 (77.2)	65/92 (70.6)
Tumor ≥ 2 cm	74/85 (87.1)	82/85 (96.5)
Total	145/177 (81.9)	147/177 (83.1)
Reader 2, n (%)		
Tumor < 2 cm	69/92 (75)	68/92 (73.9)
Tumor ≥ 2 cm	74/85 (87.1)	80/85 (94.1)
Total	143/177 (80.8)	148/177 (83.6)

Table 4. Interreader Agreement Regarding HCC Diagnosis

	Non contrast MRI	Abbreviated MRI
Reader1 - Reader2		
κ Value	0.859±0.03 [0.80-0.92]	0.838±0.03[0.78-0.90]

Conclusions

USG is not a perfect tool for HCC surveillance

Abbreviated MRI is a promising modality for HCC surveillance because of its potential for acceptable diagnostic performance and cost-saving

Even drastic trial using non-contrast MRI are gaining attention