Advanced Medical Physics Improves Patient Outcomes

Academic research on Liver MRI

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Liver MRI: Contents

สวัสดีครับ

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Liver MRI: Gd-EOB-DTPA

Image analysis

Workflow improvement

Liver MRI: Contents

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Liver MRI: Gd-EOB-DTPA

Image analysis

Workflow improvement

Background: Liver MRI

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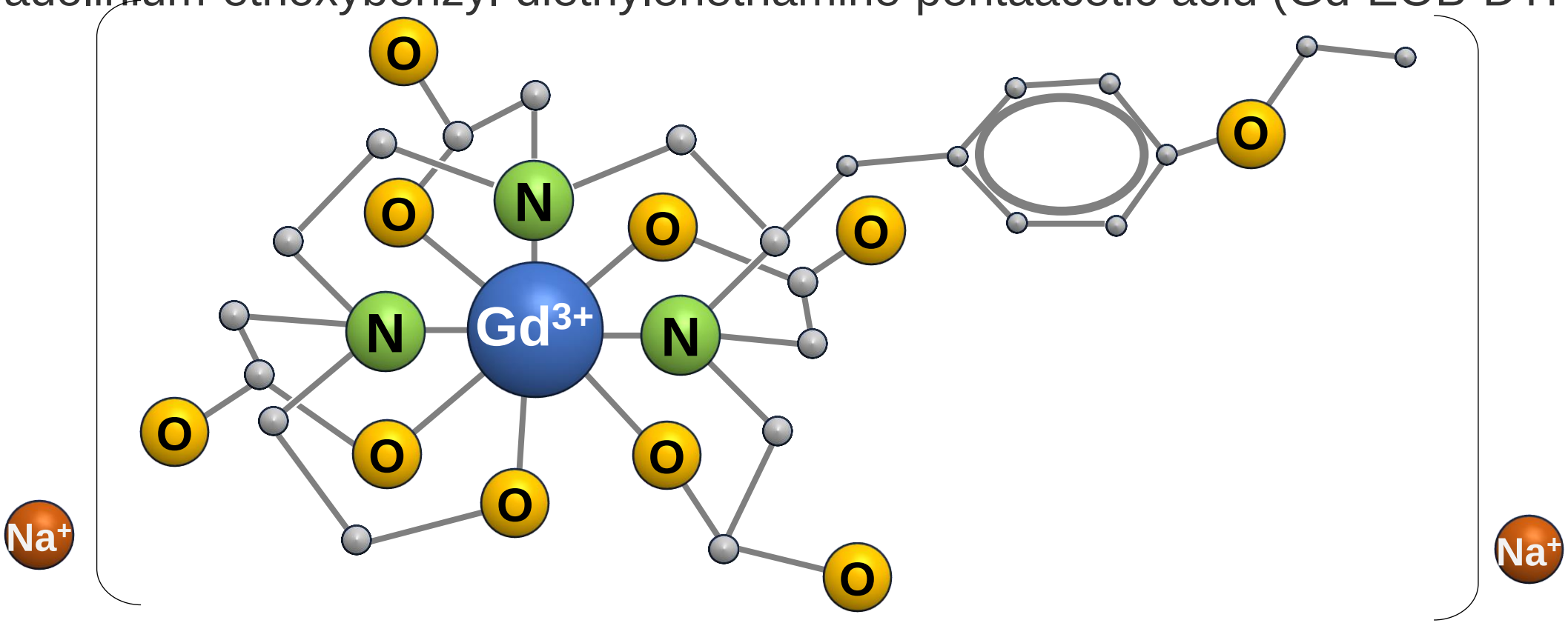
Gadolinium-ethoxybenzyl-diethylenetriamine pentaacetic acid (Gd-EOB-DTPA)



https://pharma-navi.bayer.jp/sites/g/files/vrxlpx9646/files/2021-12/EOB_PRI_202112070.pdf

Contents

Background: Liver MRI

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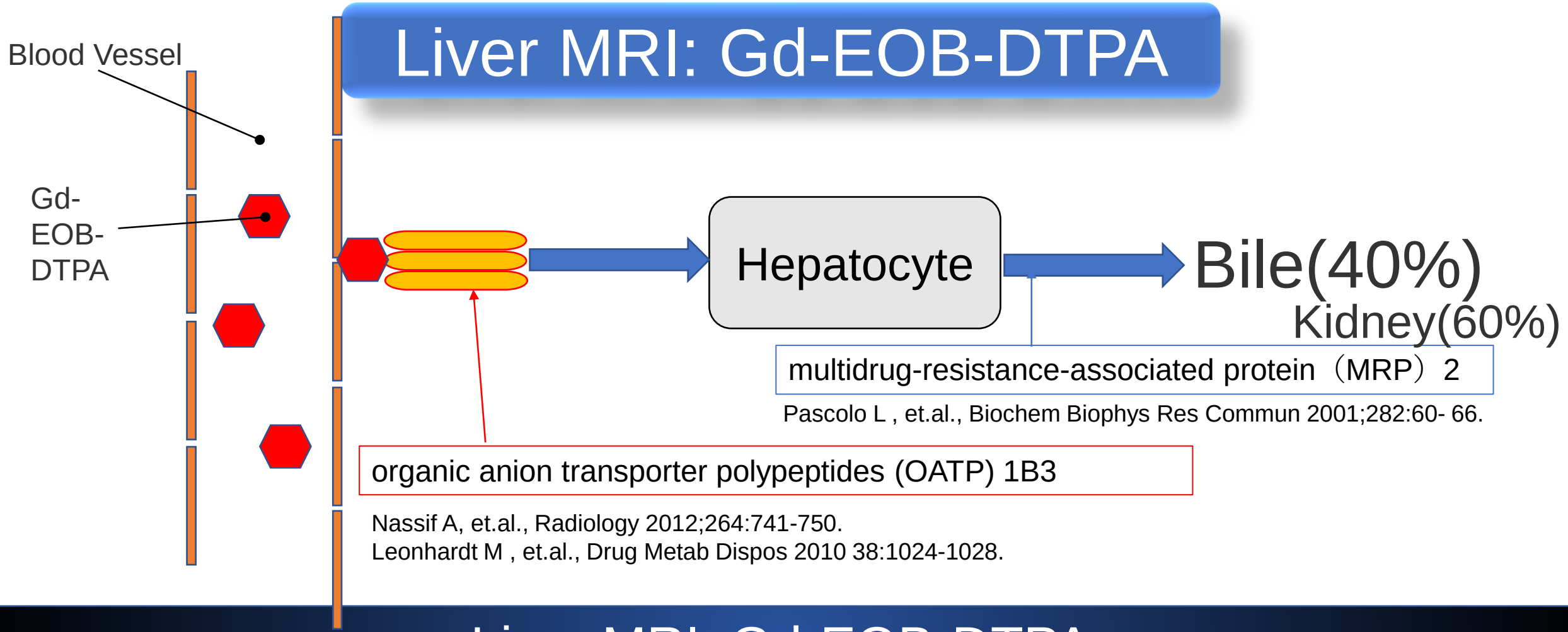

Liver MRI: Gd-EOB-DTPA

Background: Liver MRI

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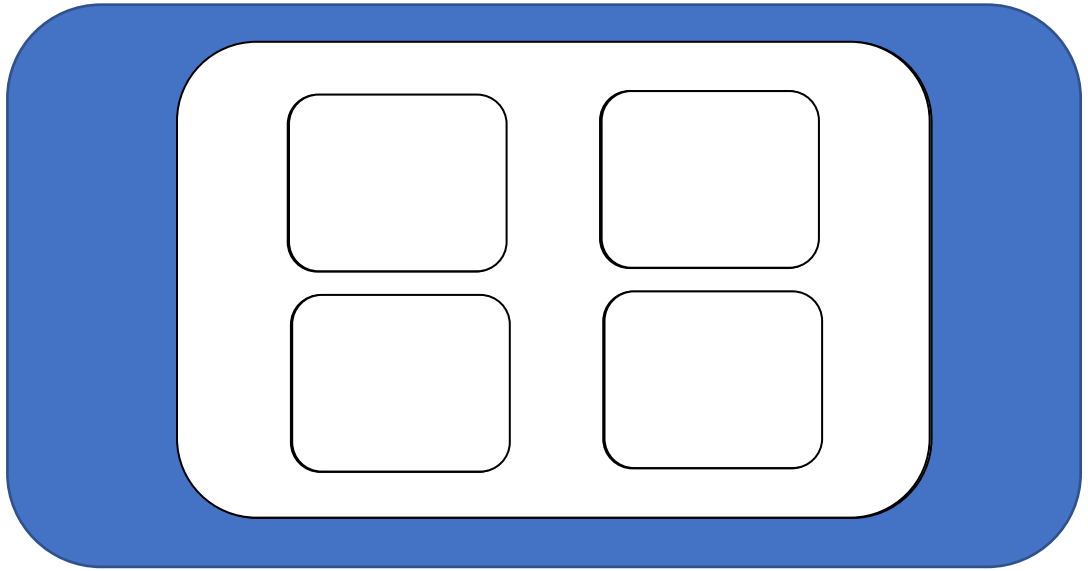
Liver MRI: Gd-EOB-DTPA



IV; Gd-EOB-DTPA accumulates in the liver over time.

Background: Liver MRI

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Contrast Pattern

Tumor without hepatocytes

e.g., metastasis, cyst, necrosis
HCC

Tumors including hepatocytes

e.g., AH, FNH, A-P shunt

Background: Liver MRI

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Liver MRI: Gd-EOB-DTPA

Gd-EOB-DTPA accumulates in the liver over time.

Dynamic images

Hepatobiliary phase (HBP)

20 min delay

Background: Liver MRI

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HBP:
tumors can be easily determined.

20 min delay

Liver MRI: Contents

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Liver MRI: Gd-EOB-DTPA

Image analysis

Workflow improvement

Image Analysis

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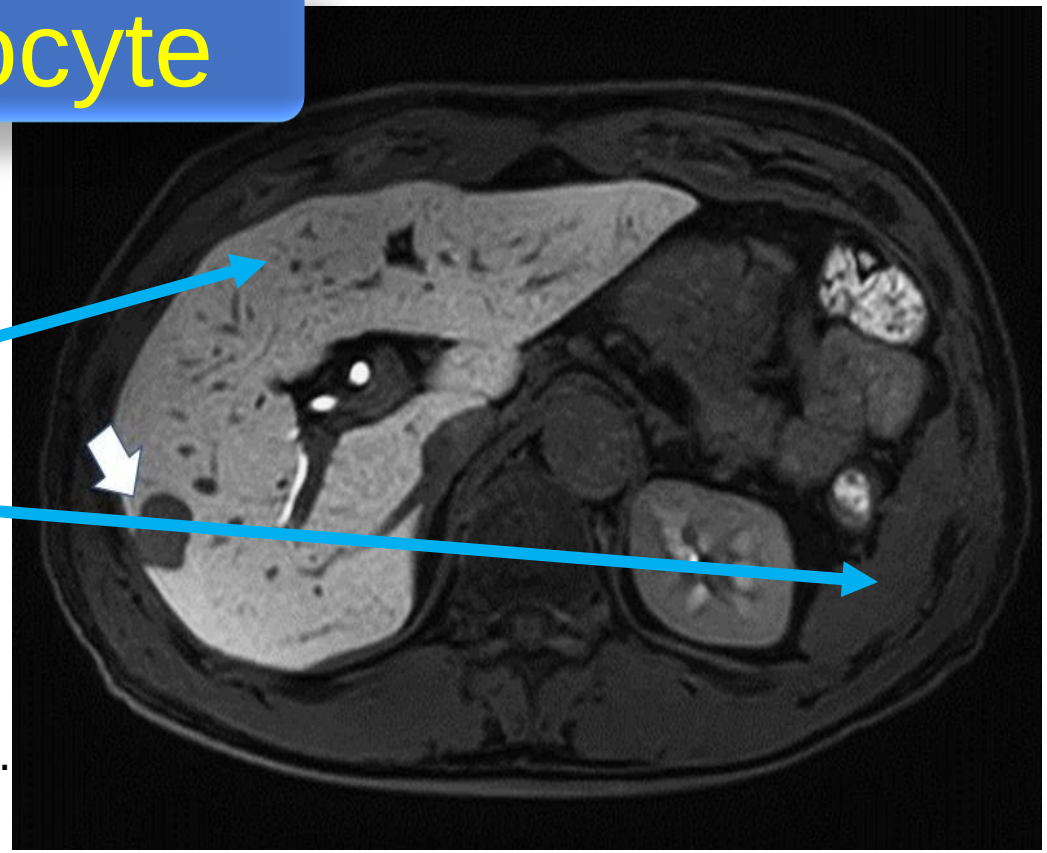
Uptake Analysis for Hepatocyte

Quantitative liver-spleen contrast ratio (Q-LSC)

$$Q\text{-}LSC = SI_L / SI_S$$

Cutoff = 1.5



The cutoff value at which tumors can be easily determined is 1.5.

Motosugi U , et.al., J Magn Reson Imaging 2009;30:1042- 1046.

Liver Function

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Analysis for the Liver Function

- Child-Pugh score
- ICG-R15
- Albumin-Bilirubin (ALBI) grade

Liver Function

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Albumin-Bilirubin (ALBI) grade

Linear predictor = ($\log_{10}$bilirubin [mol/L] × 0.66)
+ (albumin [g/L] × −0.085)

grade 1; ≤ −2.60,
grade 2; > −2.60 to ≤ −1.39,
grade 3; > −1.39.

Johnson PJ , et.al., J Clin Oncol 2015;33:550- 558.

Liver Function

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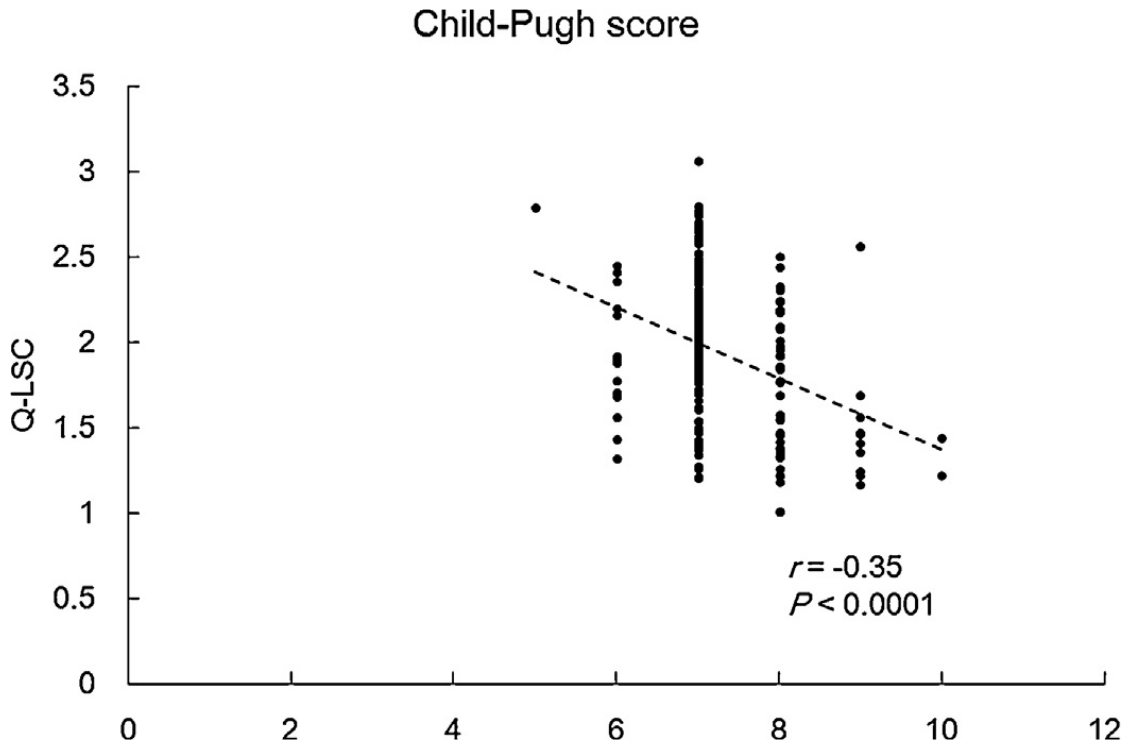

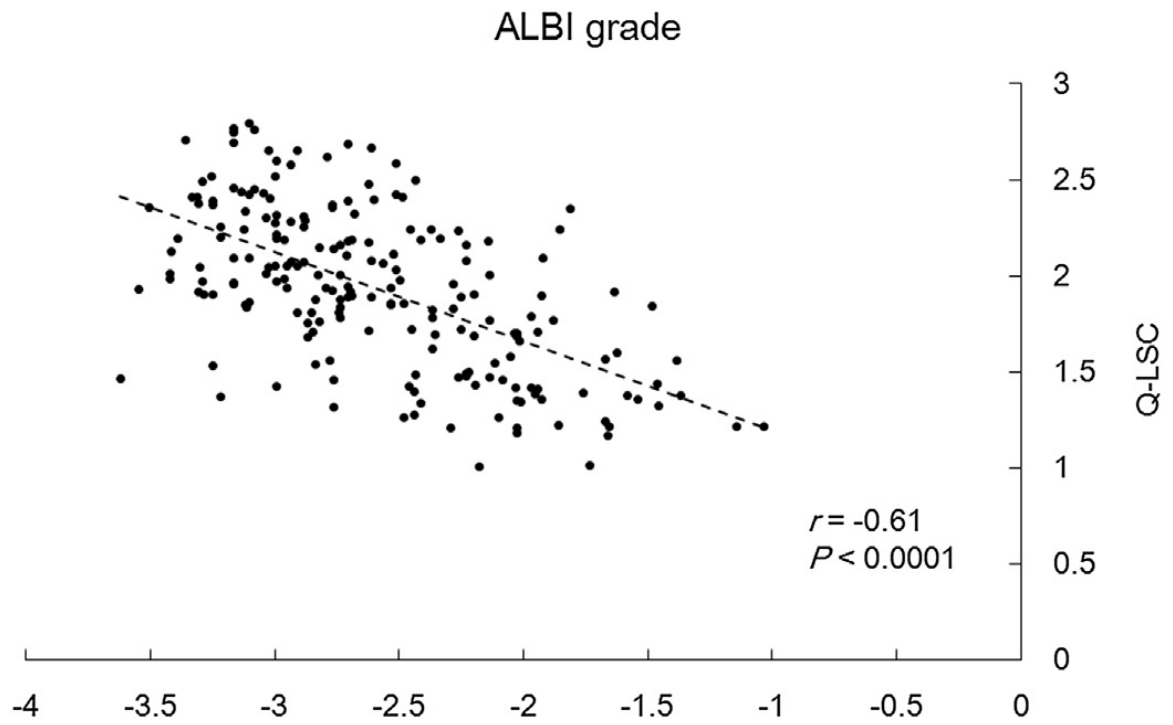

Takatsu Y, et. al., Eur J Radiol 2016; 85:2206–2210.

Liver Function

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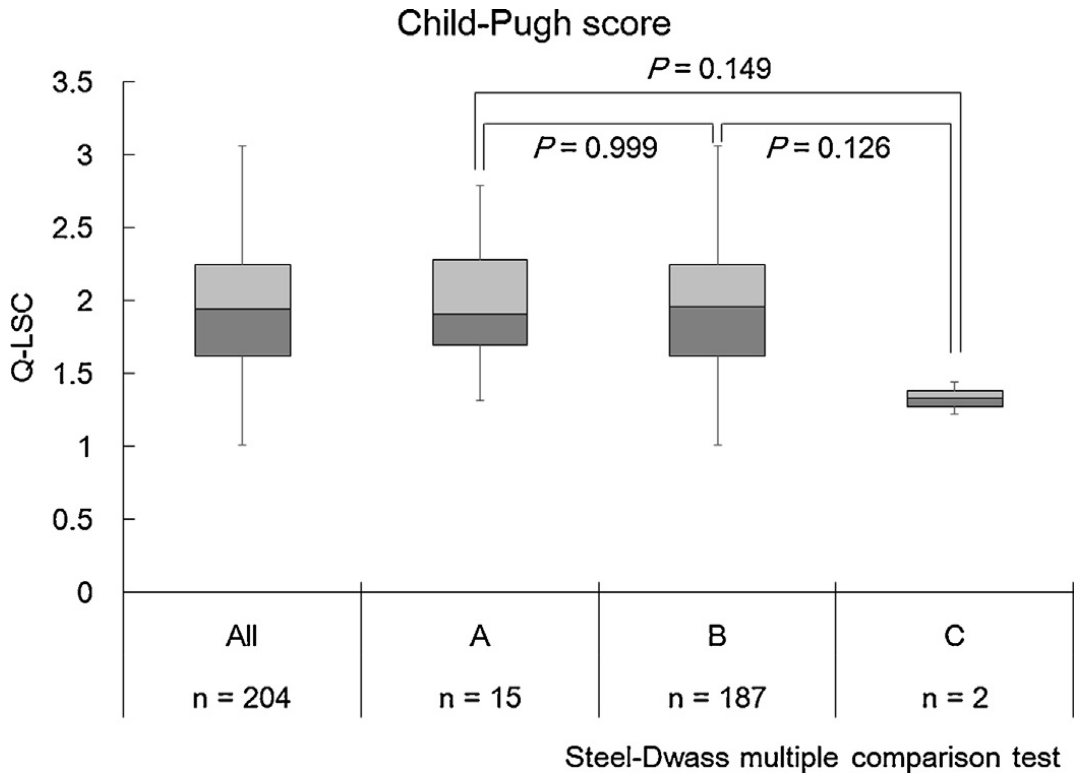

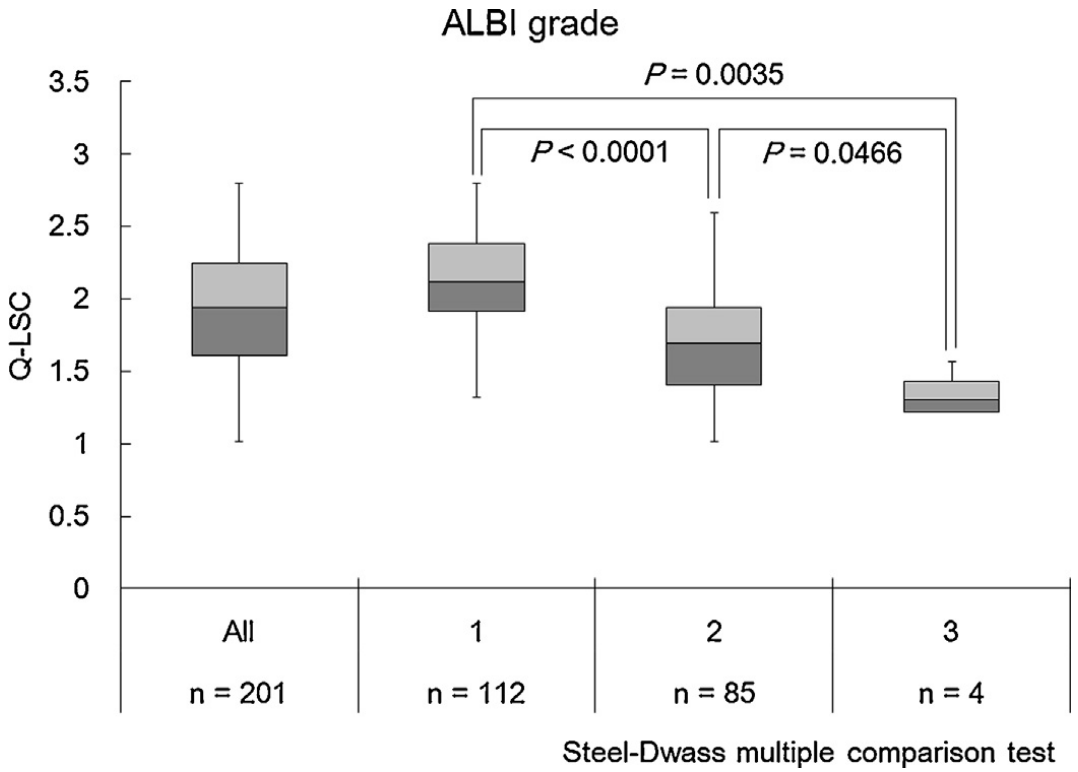

Takatsu Y, et. al., Eur J Radiol 2016; 85:2206–2210.

Liver Function

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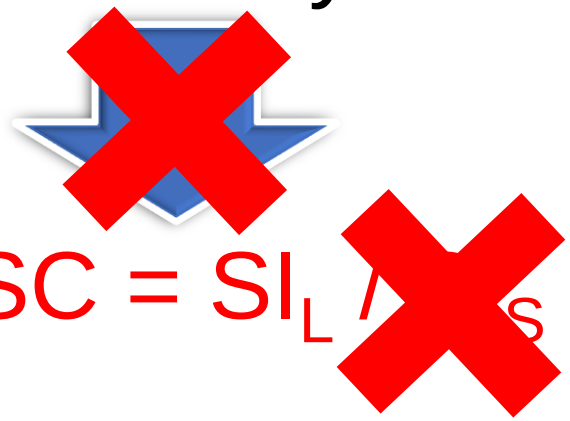
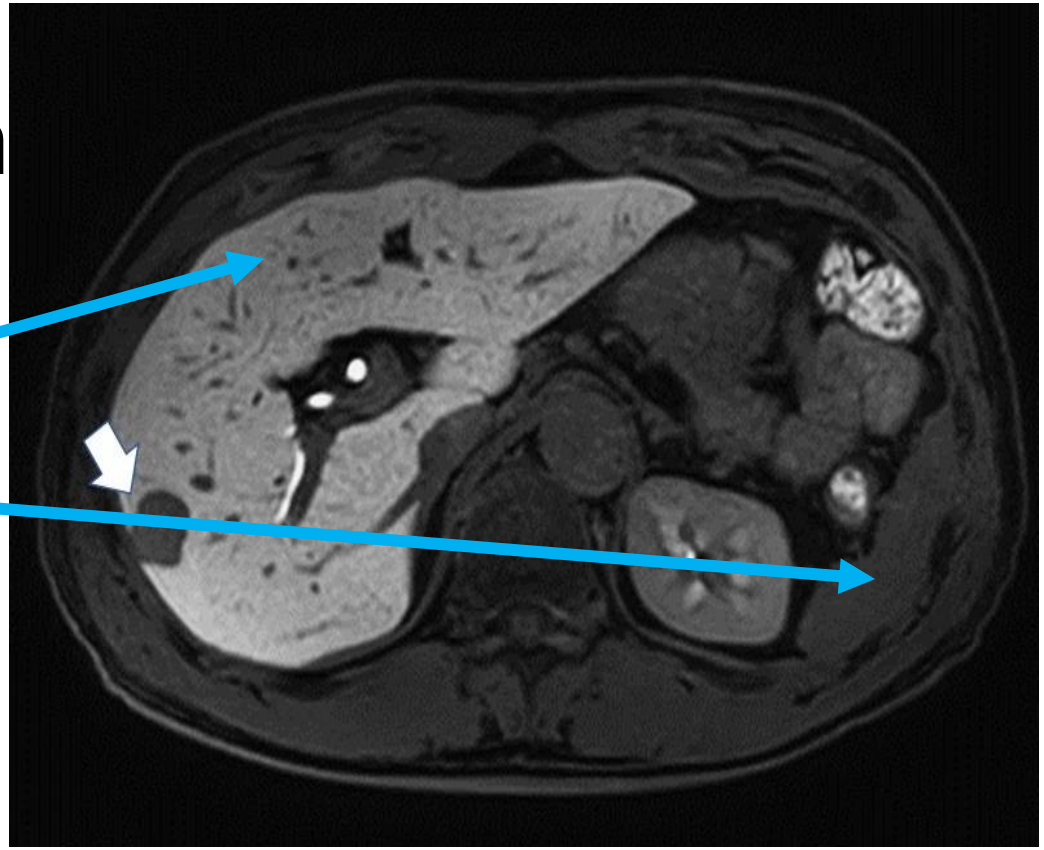
- Splenectomy
- Gamna-Gandy Bodies in spleen



$$\text{Q-LSC} = SI_L / SI_S$$



Liver Function

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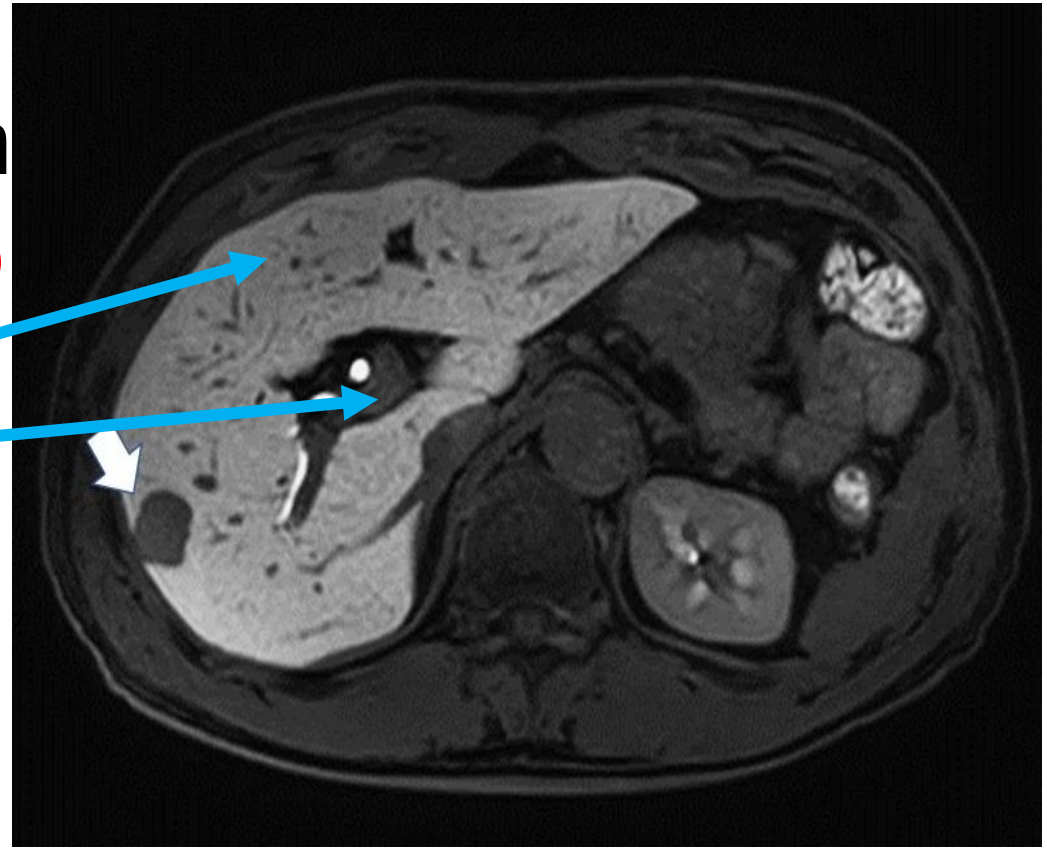
- Splenectomy
- Gamna-Gandy Bodies in spleen

Quantitative liver-portal vein contrast ratio (Q-LPC)

$$Q\text{-}LPC = SI_L / SI_p$$



Takatsu Y, et. al., Clin Imaging; 2016;40:1112-7.

Liver Function

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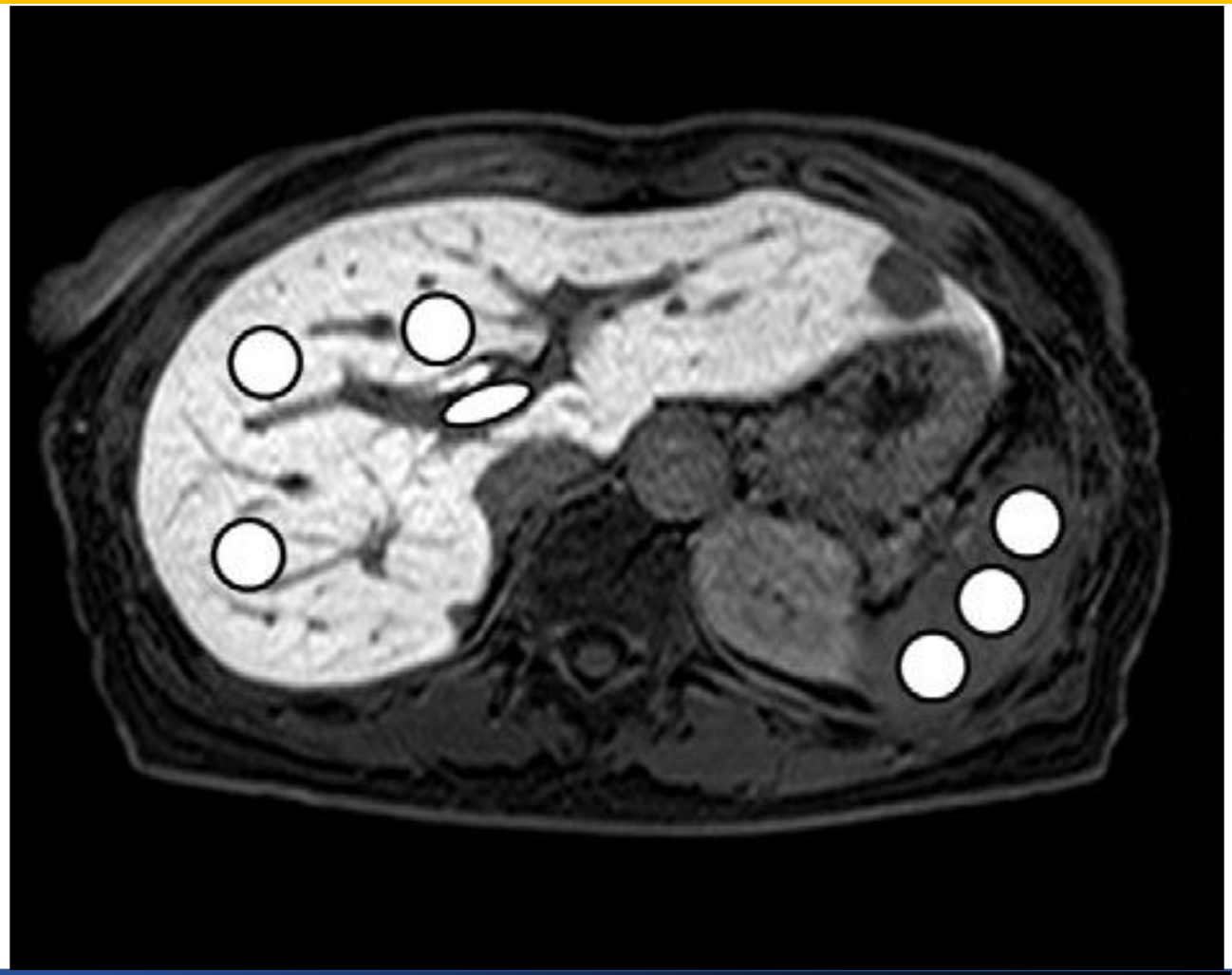
Q-QSC vs Q-LPC



Takatsu Y, et. al., Clin Imaging; 2016;40:1112-7.

Liver Function

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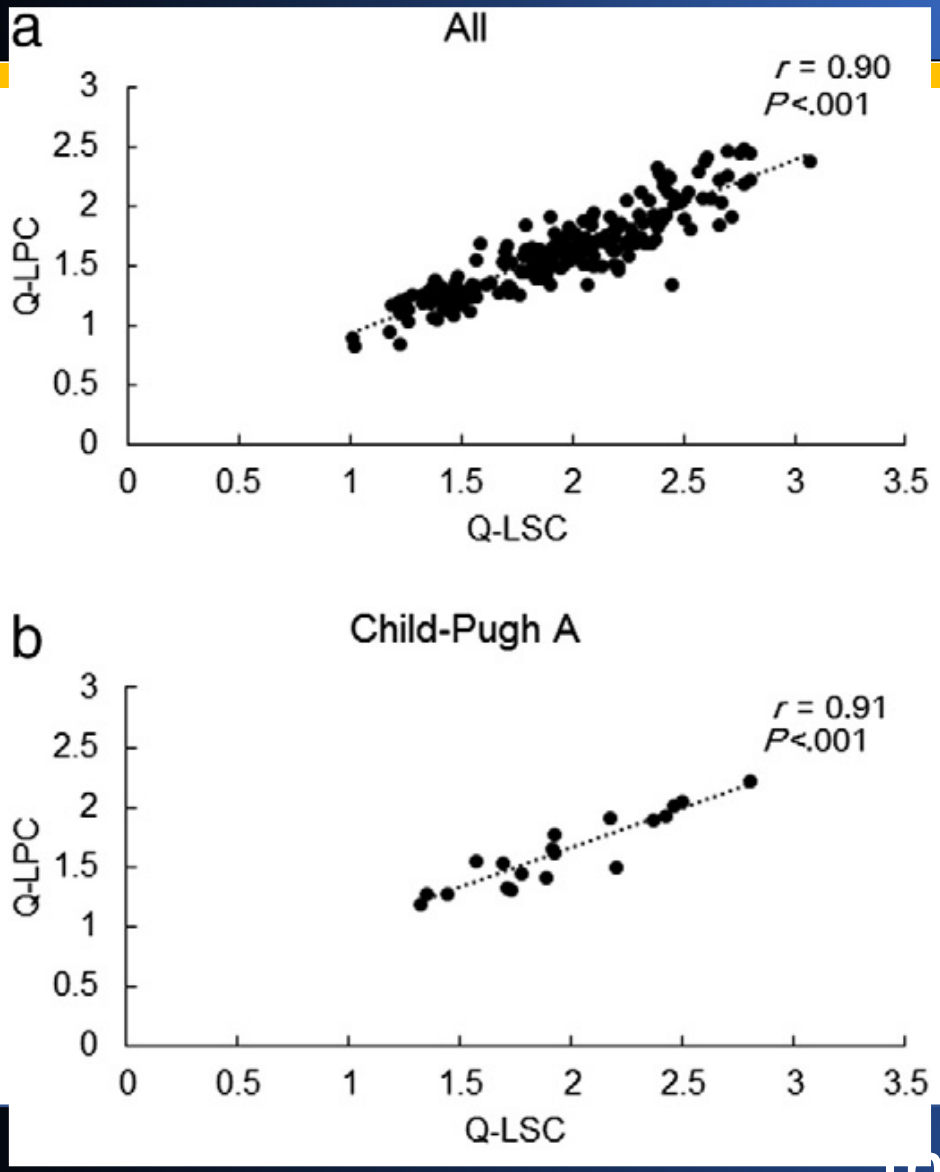

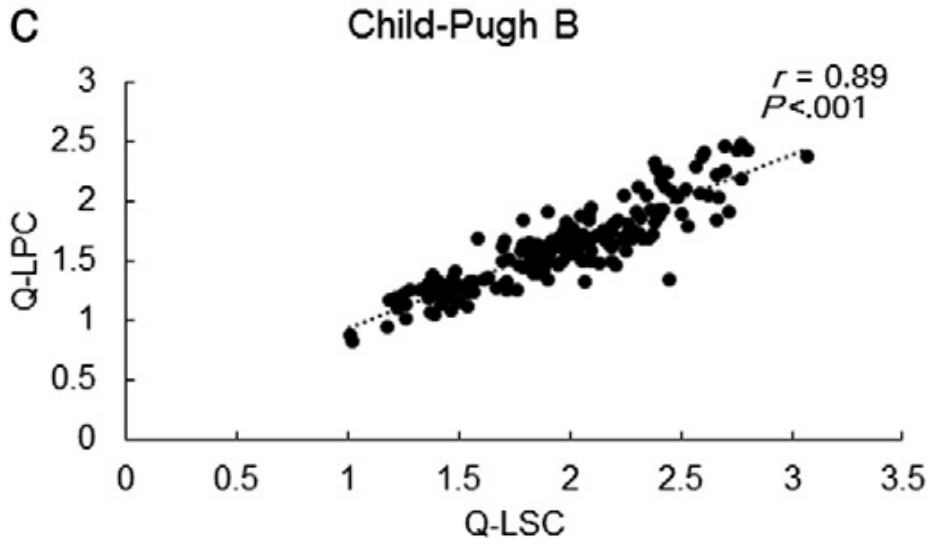

Takatsu Y, et. al., Clin Imaging; 2016;40:1112-7.

Liver Function

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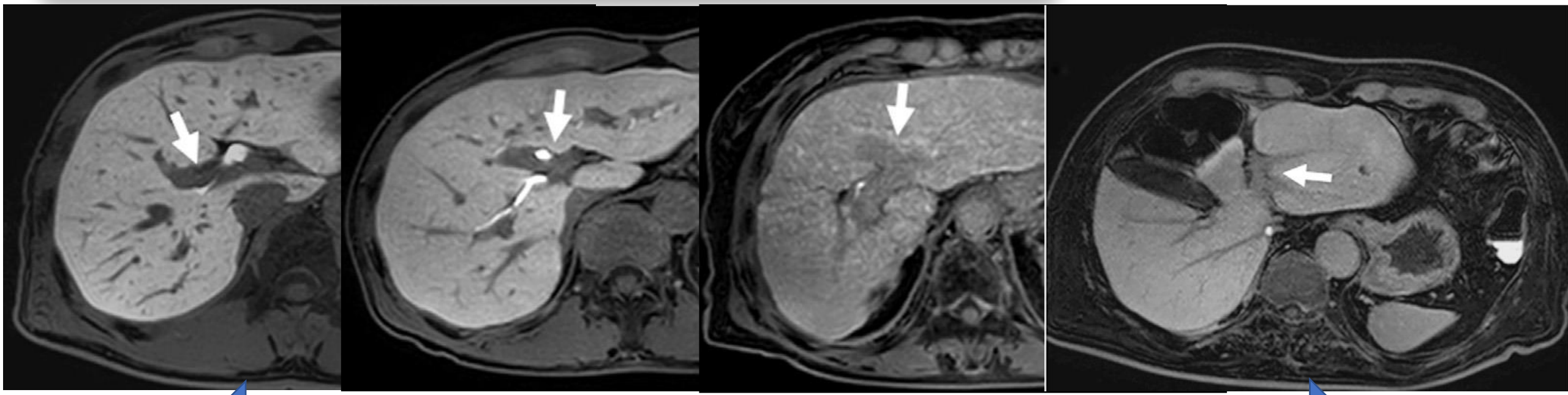
Visual Assessment



Good ← Liver Function → Poor

Takatsu Y, et. al., Clin Radiol; 2018;73:760e1-e6.

Image Analysis

Liver Function

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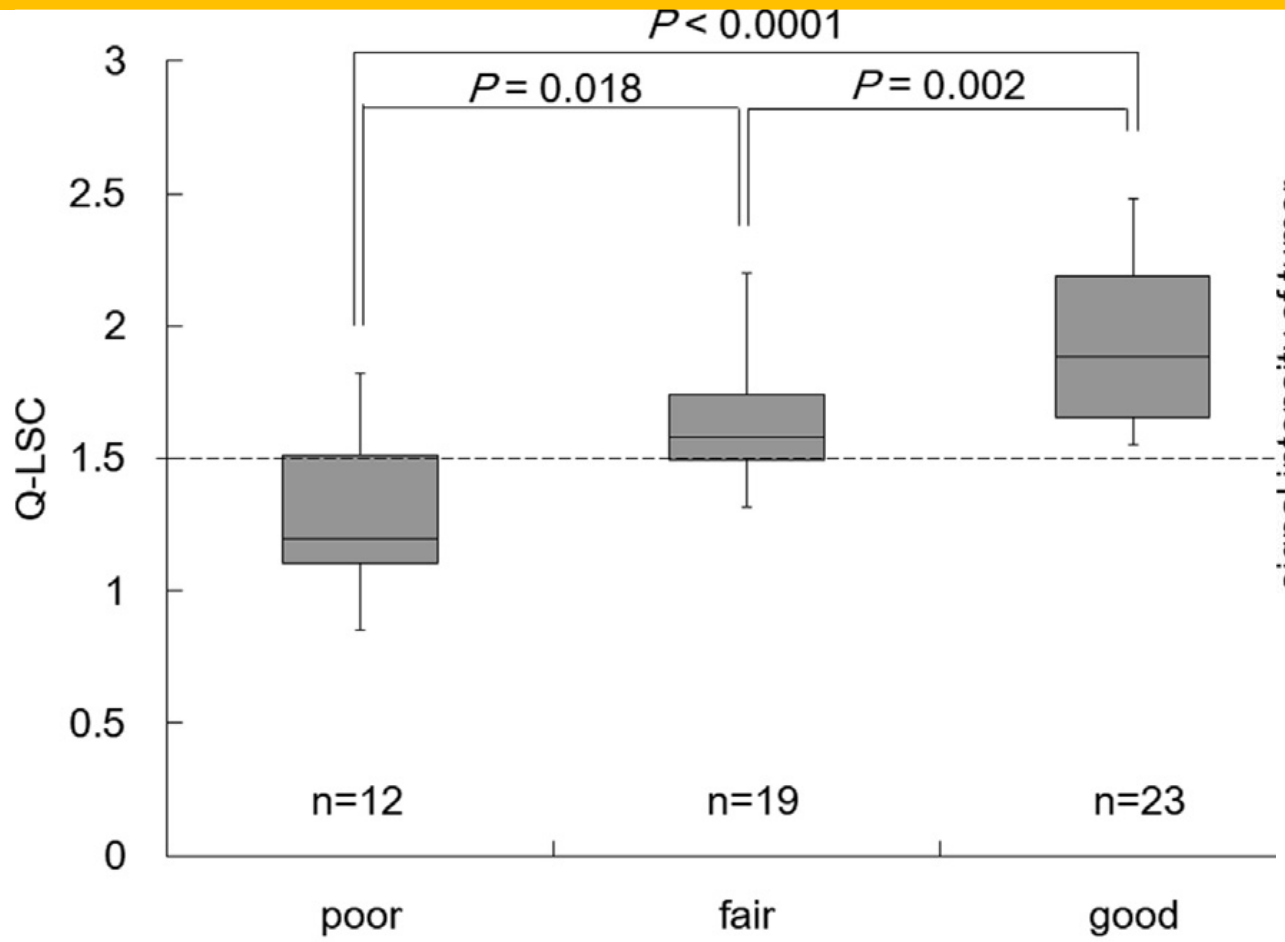
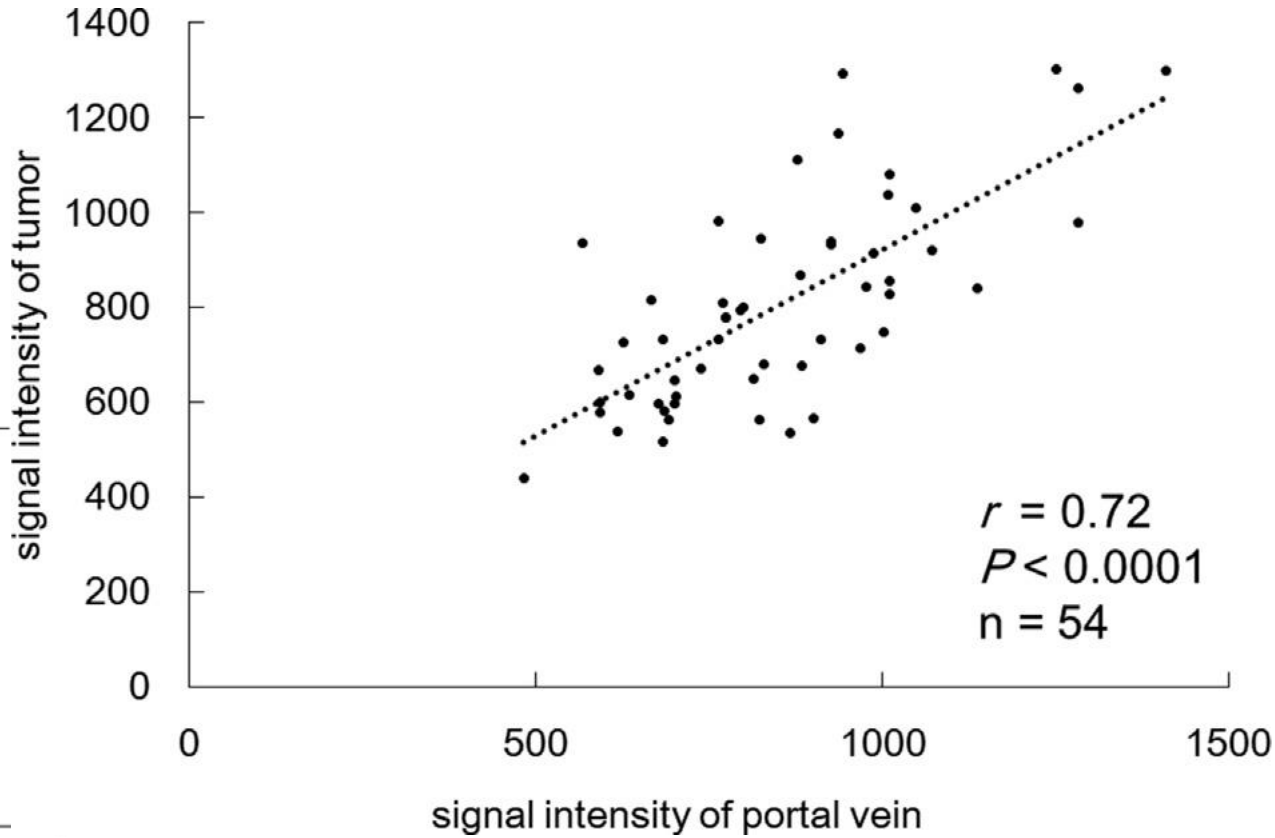


Steel-Dwass multiple comparison test



Takatsu Y, et. al., Clin Radiol; 2018;73:760e1-e6.

Liver Function

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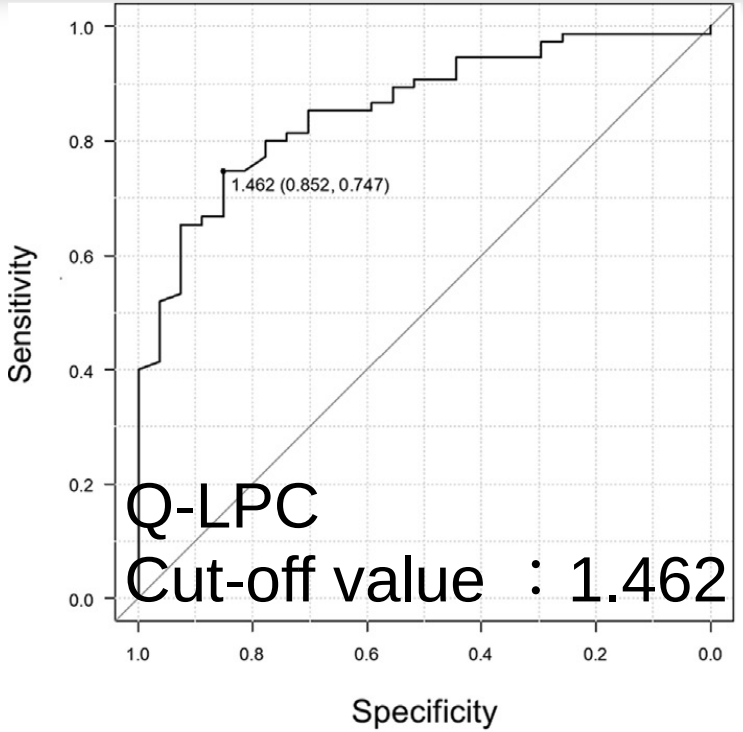
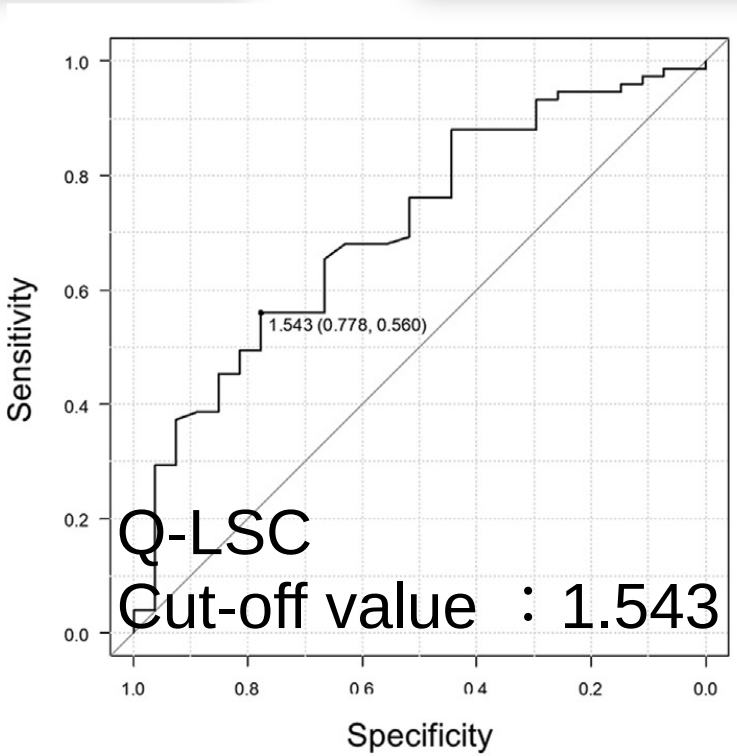
Cut-off value of Q-LPC

ROC





Takatsu Y, et. al., Clin Radiol; 2021;76:551e17-e24.

Liver Function

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Comparison between Q-LPC and Q-LSC

	Q-LPC	Q-LSC
	Estimate	Estimate
PF	0.588	0.471
Prevalence	0.735	0.735
Sensitivity	0.747	0.560
Specificity	0.852	0.778
PPV	0.933	0.875
NPV	0.548	0.389
Accuracy	0.775	0.618
LR+	5.040	2.520
LR-	0.297	0.566

l; 2021;76:551e17-e24.

Image Analysis

Liver MRI: Contents

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Liver MRI: Gd-EOB-DTPA

Image analysis

Workflow improvement

Workflow: Liver MRI

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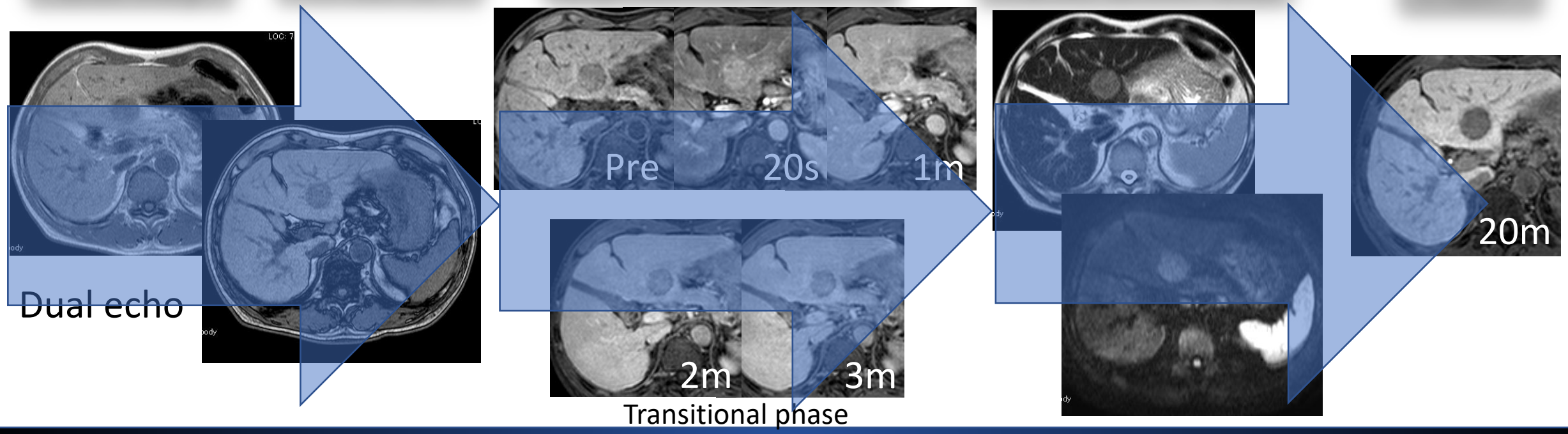
Liver MRI: Gd-EOB-DTPA: workflow

Survey | Plane | Dynamic (CE+) | T2w, DWI etc | HBP



Workflow improvement

Workflow: Liver MRI

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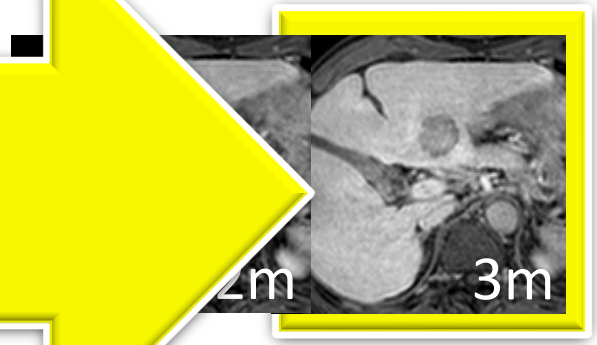
Liver MRI: Gd-EOB-DTPA: workflow

HBP

How to take a suitable HBP?

Key image



Workflow improvement

Workflow: Liver MRI

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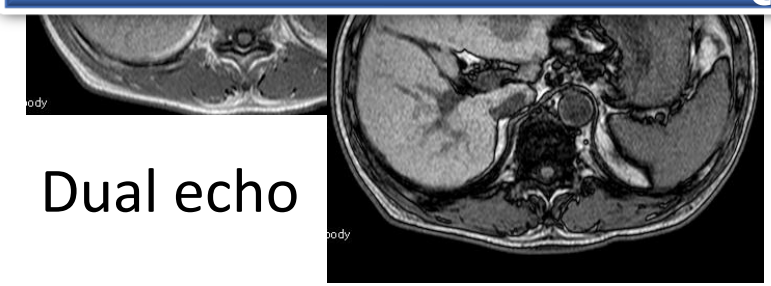
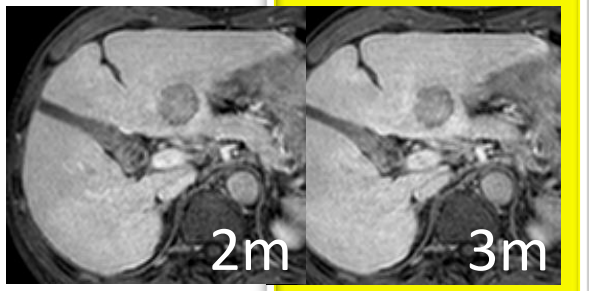
Liver MRI: Gd-EOB-DTPA: workflow

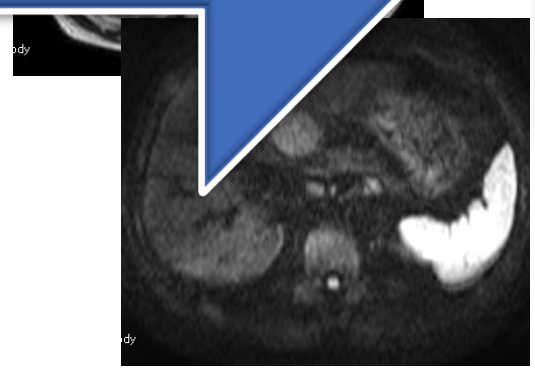
Survey | Plane | Dynamic (GE+) | T2w | HBP

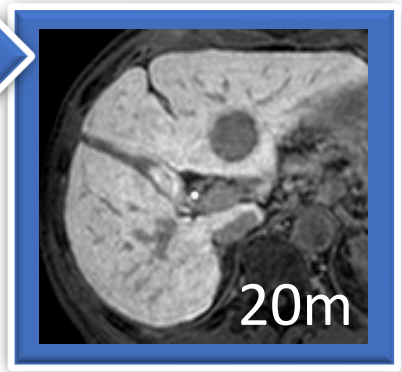
To investigate whether the contrast enhancement effect in HBP images can be predicted using transitional phase (3-min delay) images based on Q-LSC and ALBI grades.



Dual echo







Workflow improvement

Workflow: Liver MRI

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Data analysis

Q-LSC = Signal intensity of Liver / Signal intensity of Spleen

3, 10, and 15 min after Gd–EOB–DTPA injection

5 Q-LSC groups

More than 1.5?

<0.9 | ≥0.9, <1 | ≥1, <1.1 | ≥1.1, <1.2 | ≥1.2

Results

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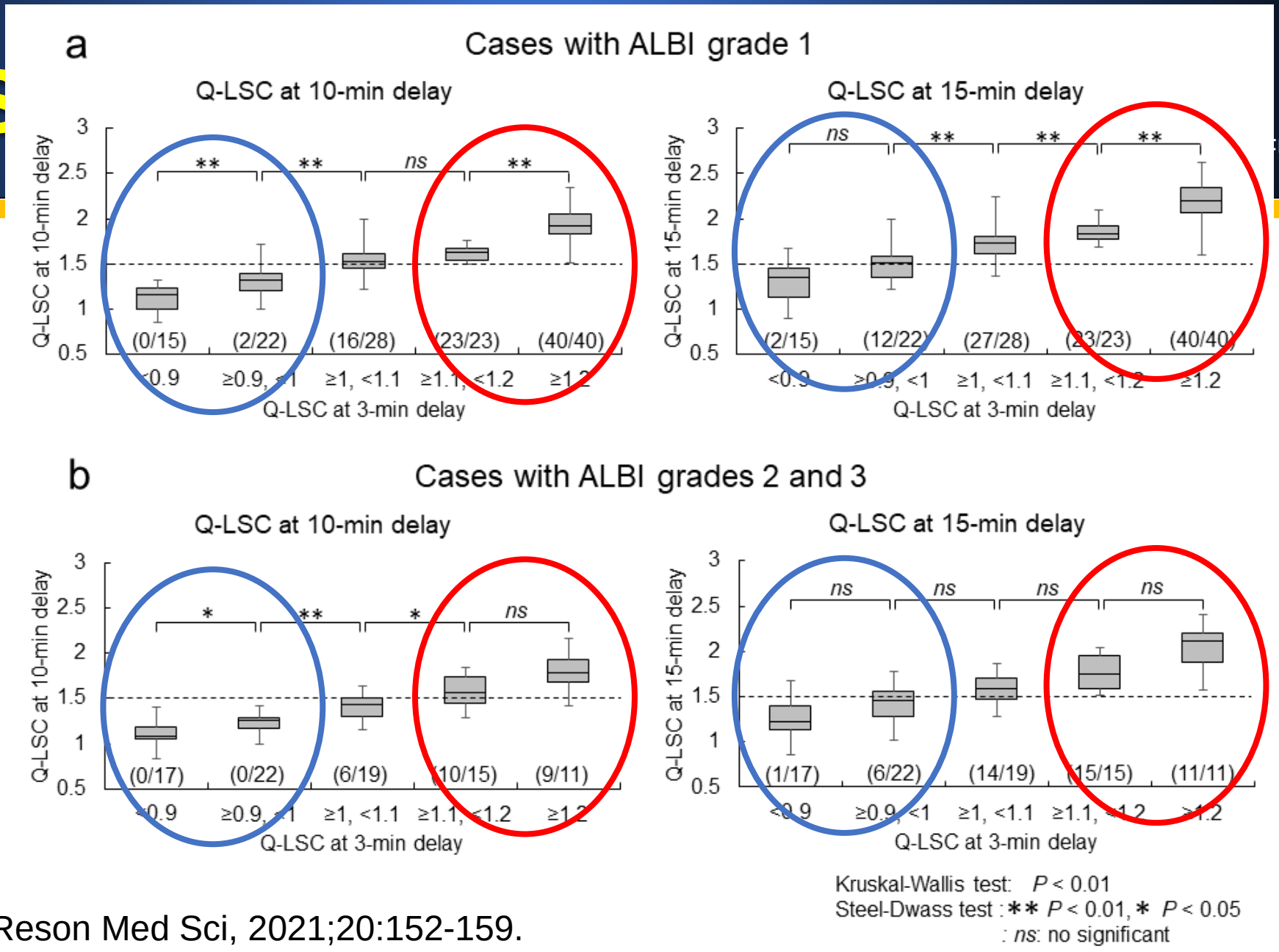

Takatsu Y, et.al., Magn Reson Med Sci, 2021;20:152-159.

Workflow improvement

Results

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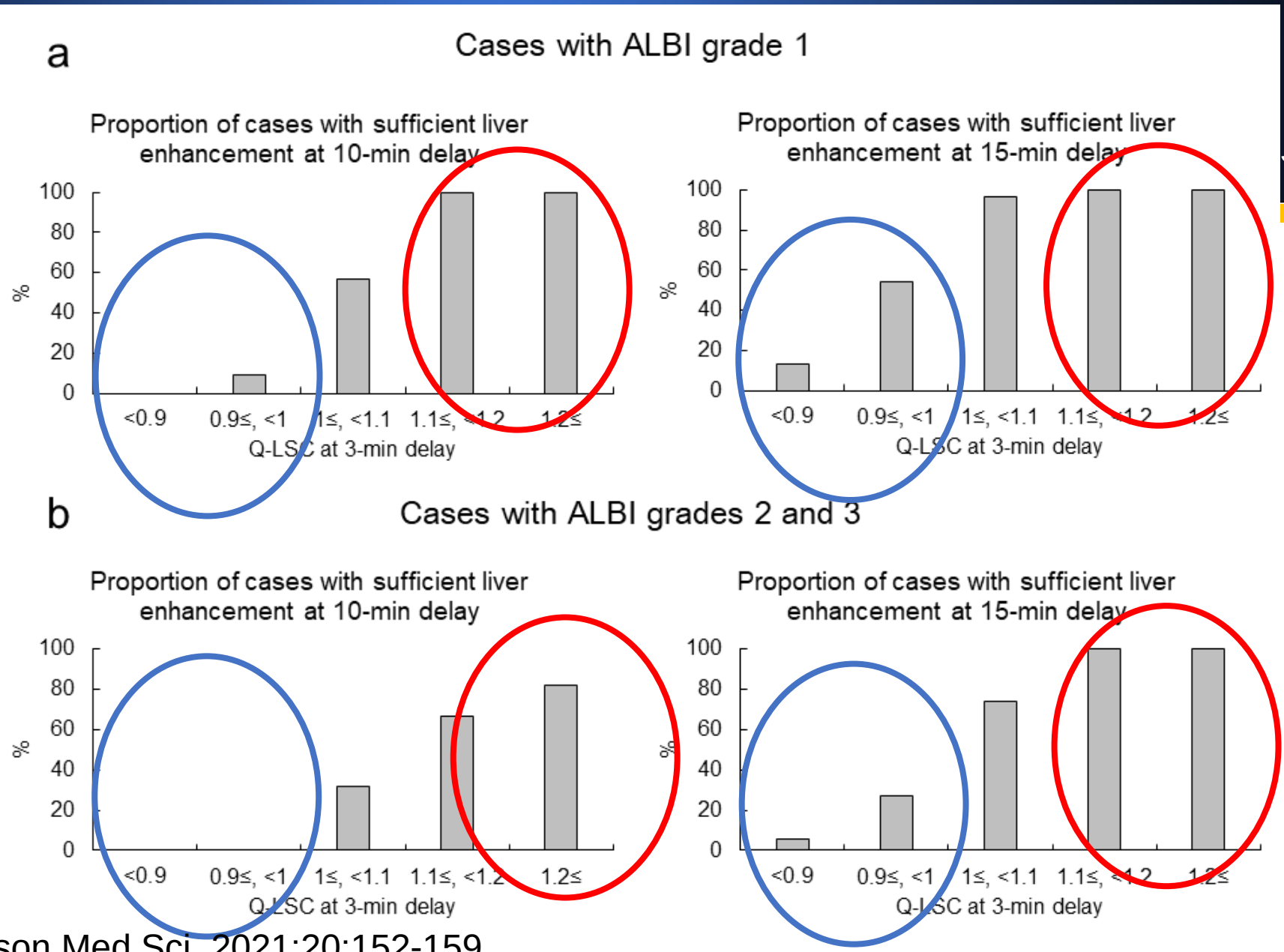

Takatsu Y, et.al., Magn Reson Med Sci, 2021;20:152-159.

Workflow improvement

Results/Discussion

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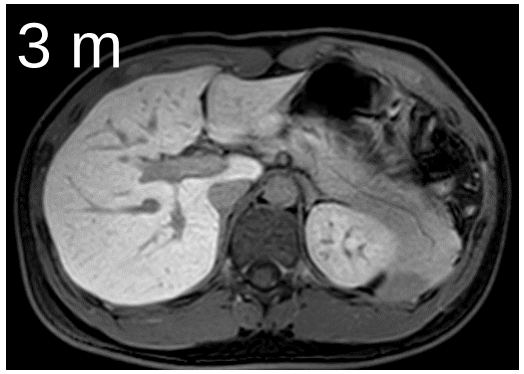
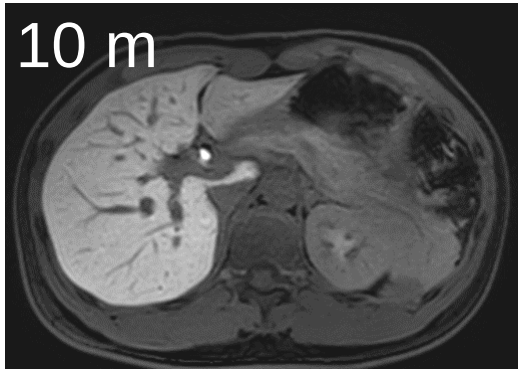
Q-LSC:

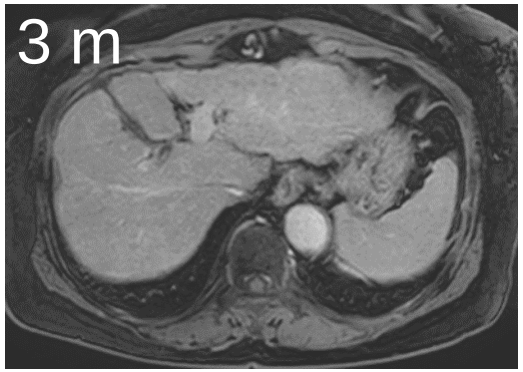




ALBI grade 1 ≥1.1
ALBI grades 2 and 3 ≥1.2

Q-LSC ≥ 1.5 100%
81.8%

Long examination
Patient's fatigue
Insufficient breath hold
Body movement
Poor physical condition



ALBI grade 1
ALBI grades 2 and 3 <1

Q-LSC ≥ 1.5 37.8%
17.9%

Super delay

Workflow improvement

Discussion

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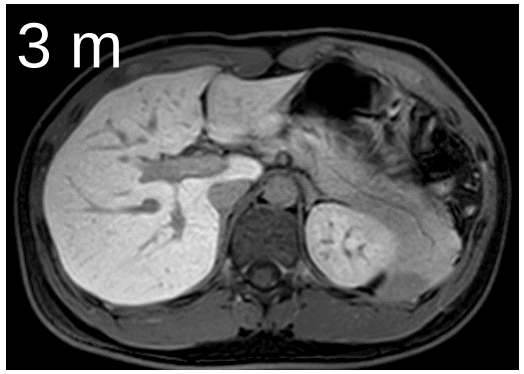
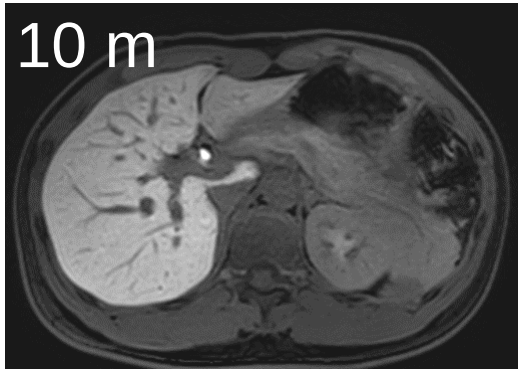
Q-LSC:

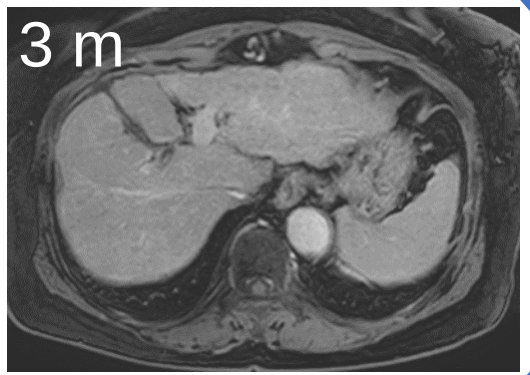




End of the examination

ALBI grade 1 ≥1.1
ALBI grades 2 and 3 ≥1.2

Q-LSC ≥ 1.5 100%
81.8%



Stop temporally

ALBI grade 1
ALBI grades 2 and 3 <1

Another patient can be performed instead of wasting time while waiting

Continued to HBP

Workflow improvement

Conclusion

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Liver contrast enhancement effect in HBP image could be predicted using a **3-min delay** image based on Q-LSC and ALBI grades.

Performing a smooth and well-managed study

Workflow improvement

Liver MRI: Contents

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Liver MRI: Gd-EOB-DTPA

Image analysis

Workflow improvement

Thank you for your attention

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Liver MRI: Gd-EOB-DTPA

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