

ESMO 18th World Congress on Gastrointestinal Cancer

Barcelona, Spain 29. Jun - 02. Jul 2016

Session VII:

Rare Tumors: Neuroendocrine Tumors, Gastrointestinal Stomal Tumors, and Anal Cancer

Tandem Talk 1: Imaging in NET Contribution of CT and MRI

T. Denecke

Klinik für Radiologie
Campus Virchow-Klinikum
Charité - Universitätsmedizin Berlin

Disclosures

PD Dr. med. Timm Denecke

Honoraria

Siemens, GE, Toshiba, Bayer, IPSEN, Parexel

Research funding

Siemens, Guerbet

Imaging of NET

Goals

- Detection of primary
- Detection of metastases
- Therapy planning
- Image-guided therapy
- Therapy control

NET-Features

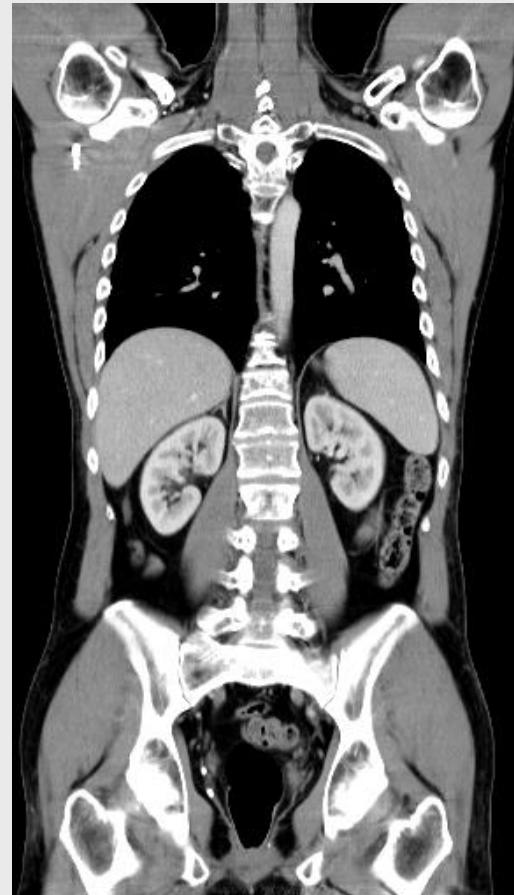
- Small lesions
- often hypervascularized
- GEP-System:
 - **Pancreas** (Insulinoma, NEC, Gastrinoma, MEN, etc.)
 - **Small bowel**
 - Multifocal
 - **Liver** metastases

MSCT Innovations

**4 Row, 1 mm ST
20 s**



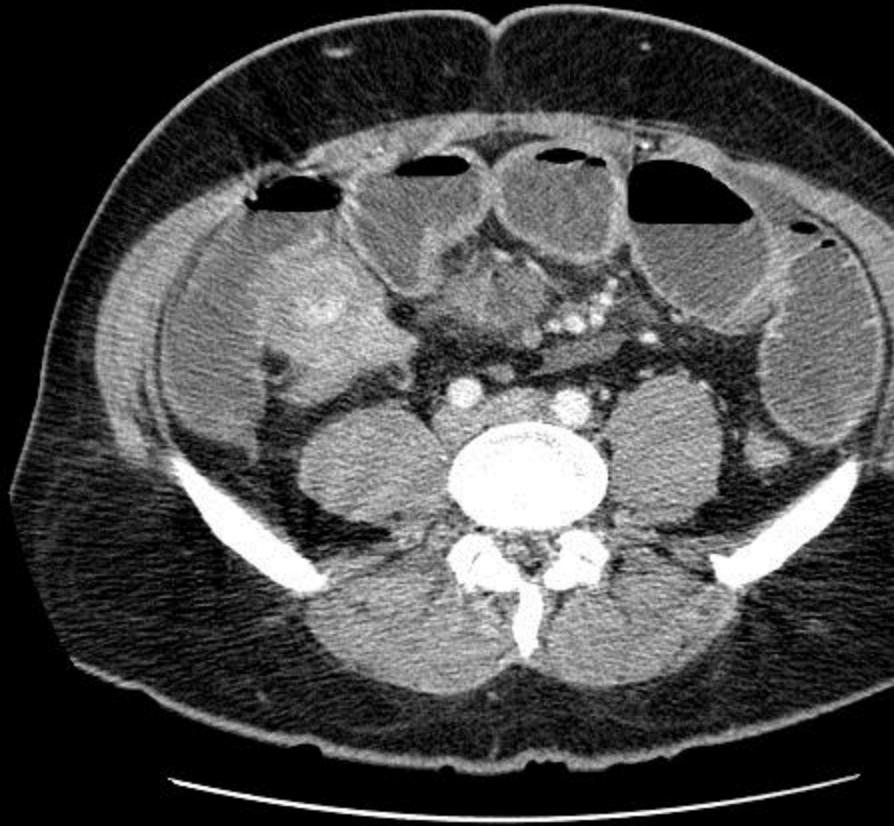
**16 Row, 1 mm ST
<20 s**



**64 Row, 0,6 mm ST
10 s**

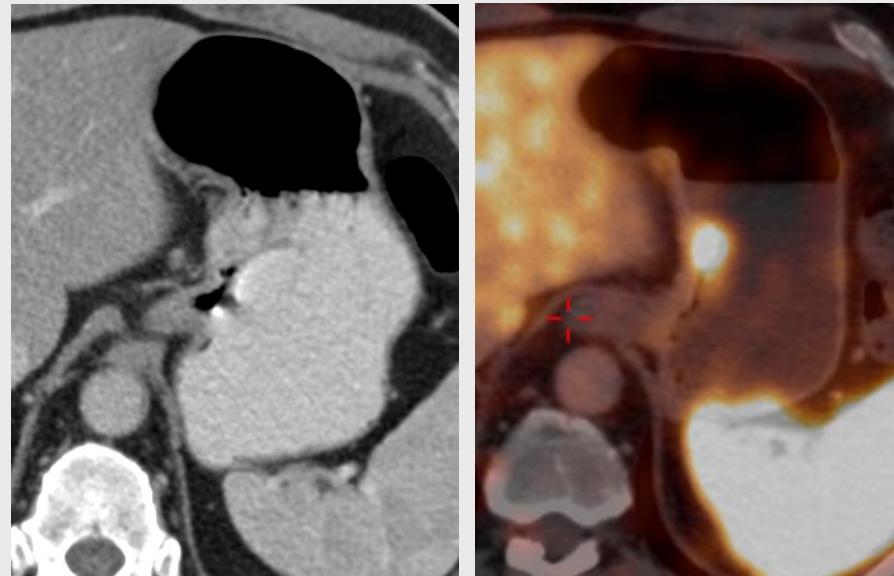


MSCT Detection of primary



Important for search of primary with CT

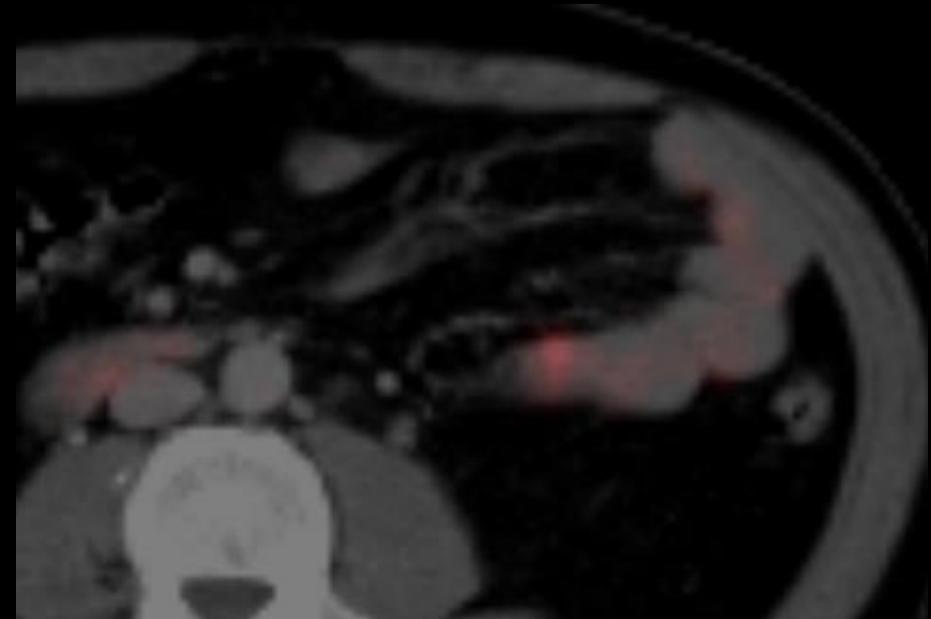
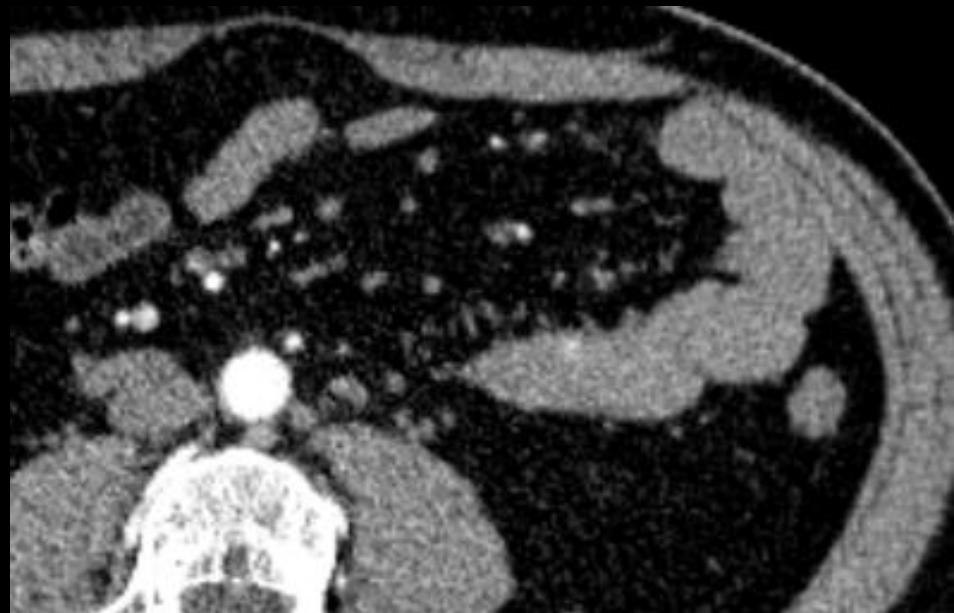
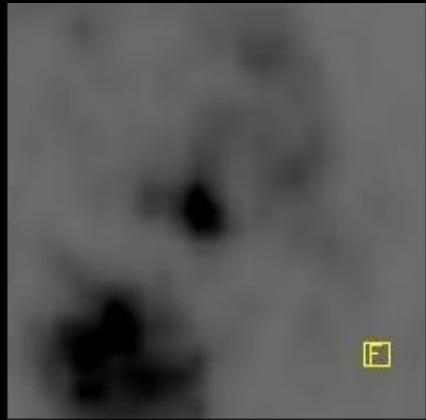
- No positive CM orally !
- Intravenous CM with high Iodine concentration and flow rate
- Early CM-phase important



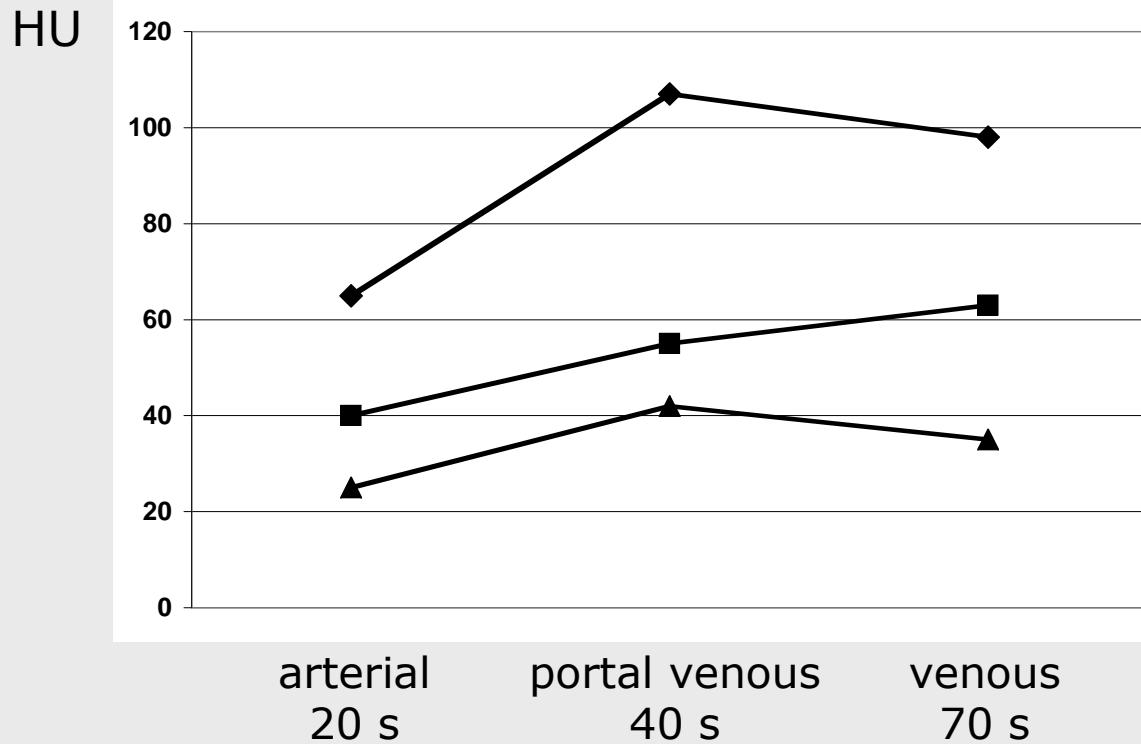
- Incl. Rectum !



NET: bifocal primary in the jejunum



Contrast Enhancement - Pancreas



Pancreas

Tumor (Adeno-Ca)

Difference

Fletcher et al. Radiology 2003

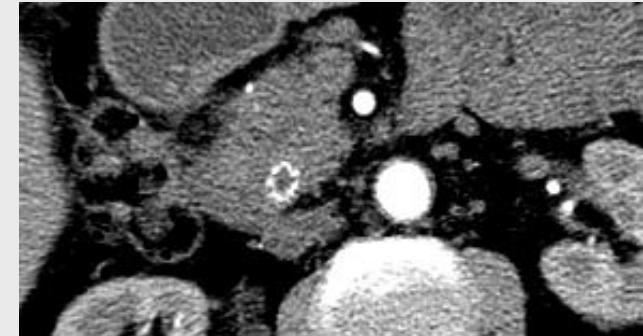
NET often behave different !

Contrast Phases - Pancreas

Upper Abdomen

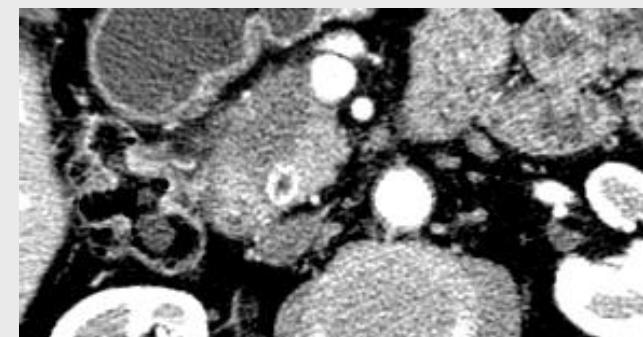
Delay

Arterial: (Bolus Tracking) 18 - 21 s



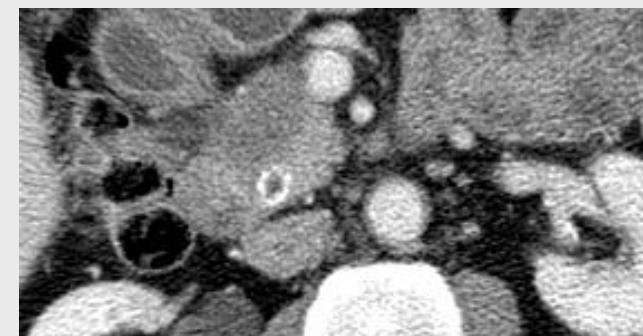
Portal venous:

38 - 41 s



Entire Abdomen

Venous: 70 s

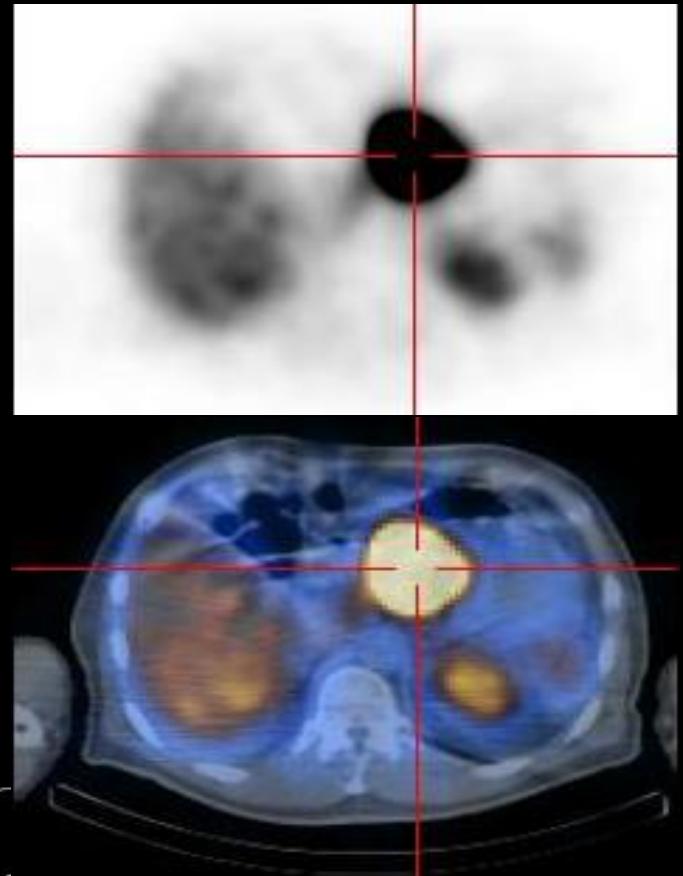


Detection / Characterisation in the arterial Phase

NET Pancreas (G2)



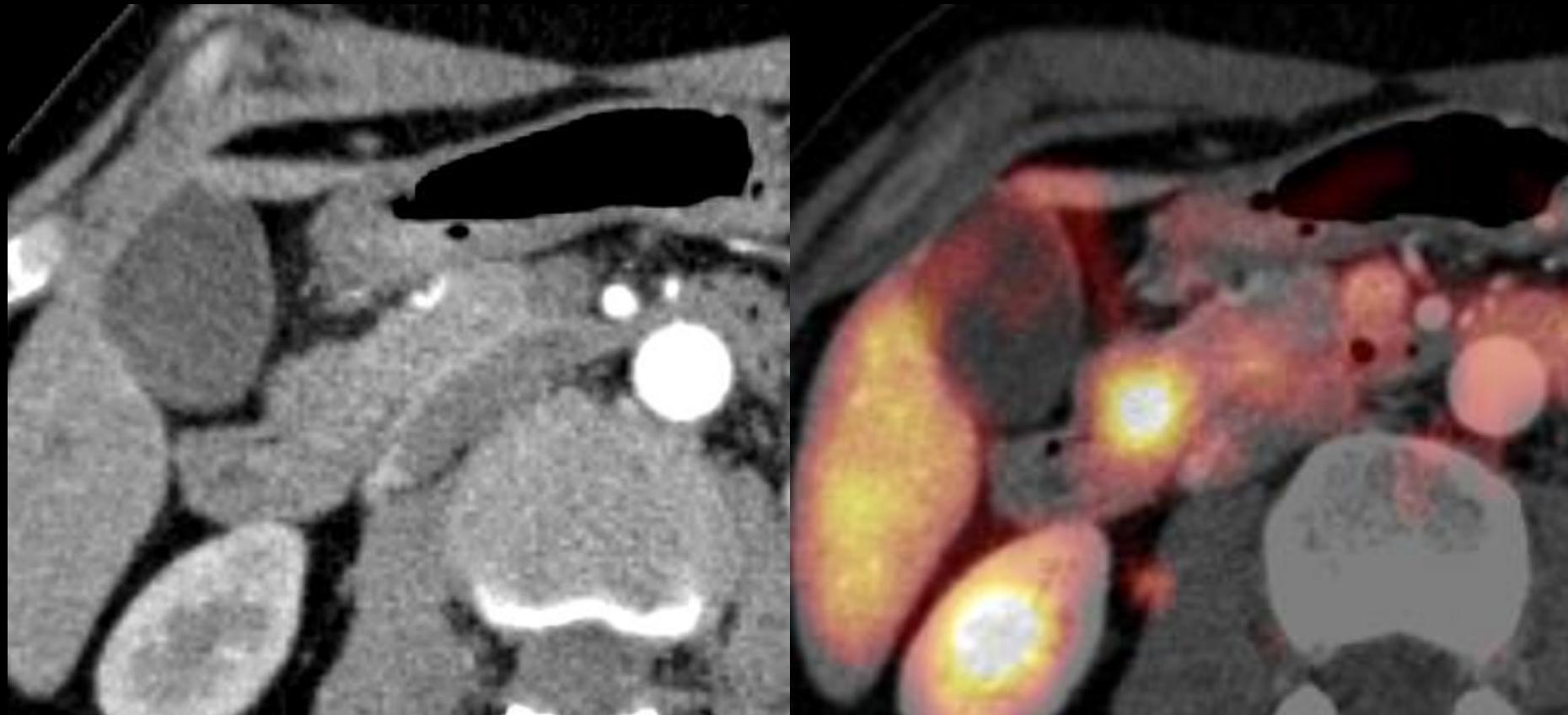
Axial (ST, 3.75 mm)



SRS, SPECT-CT

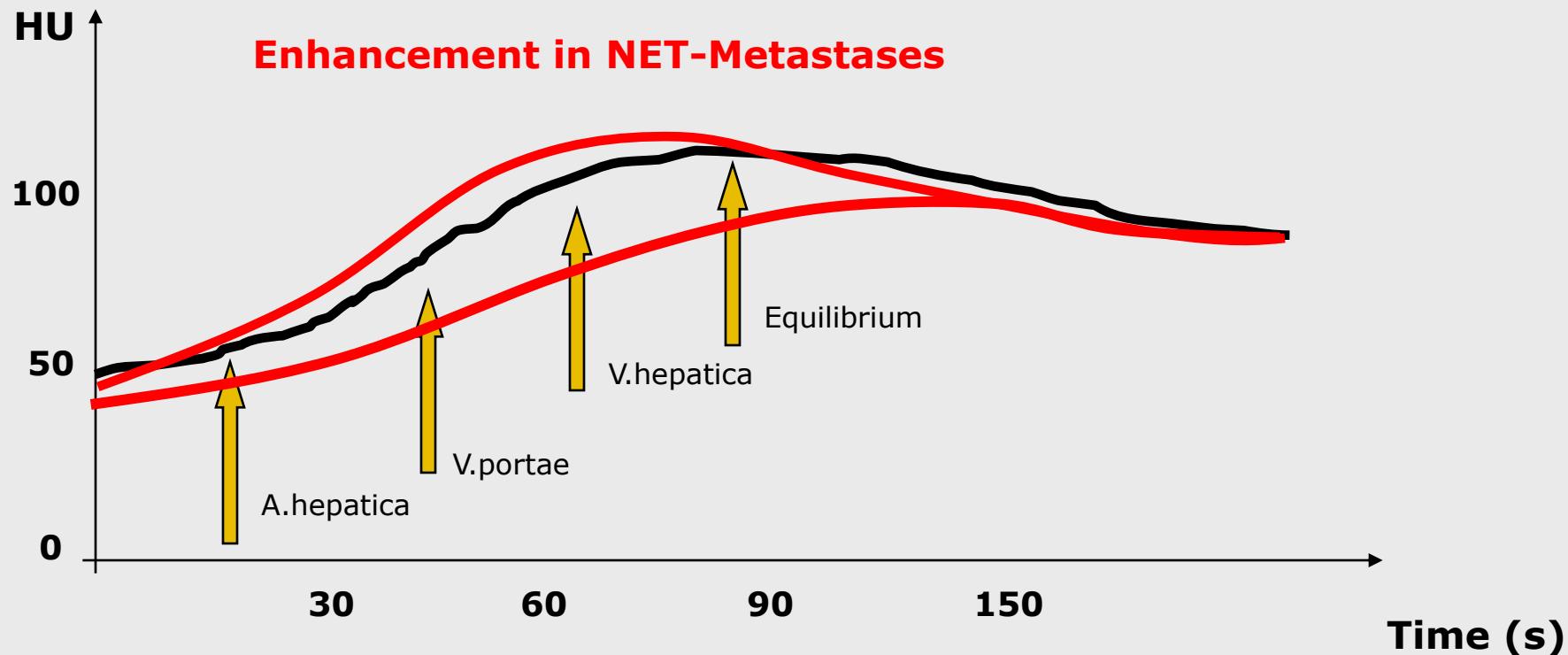
Contrast Enhancement - Pancreas

NEC pancreatic head – G3



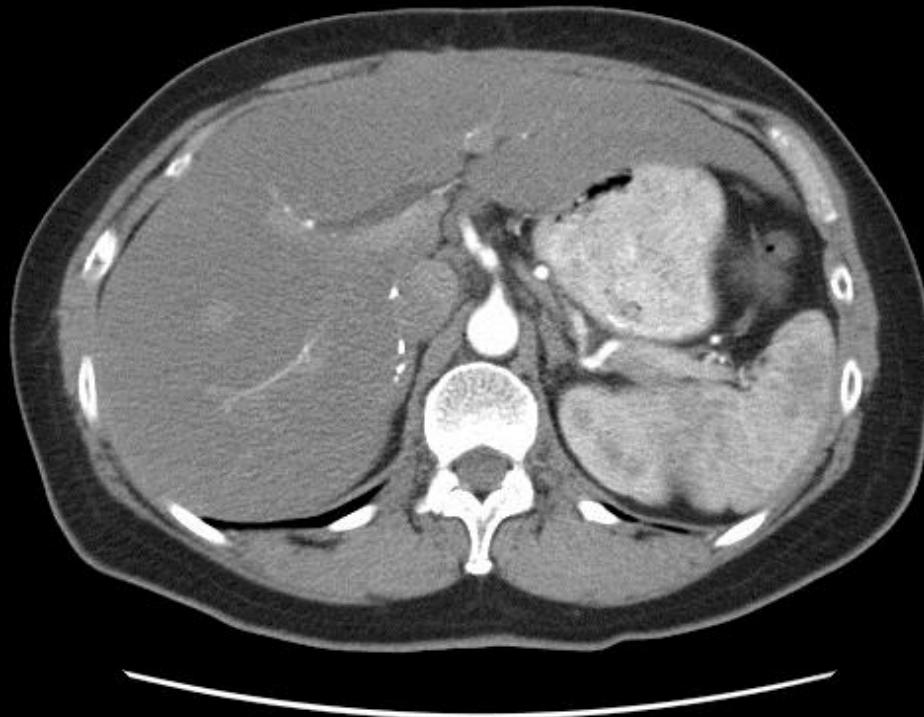
I.V. Contrast phases Liver

CT: Absorption of liver tissue from the beginning of iv CM injection



CT – Lesion Detection in the Liver

NET – liver metastasis



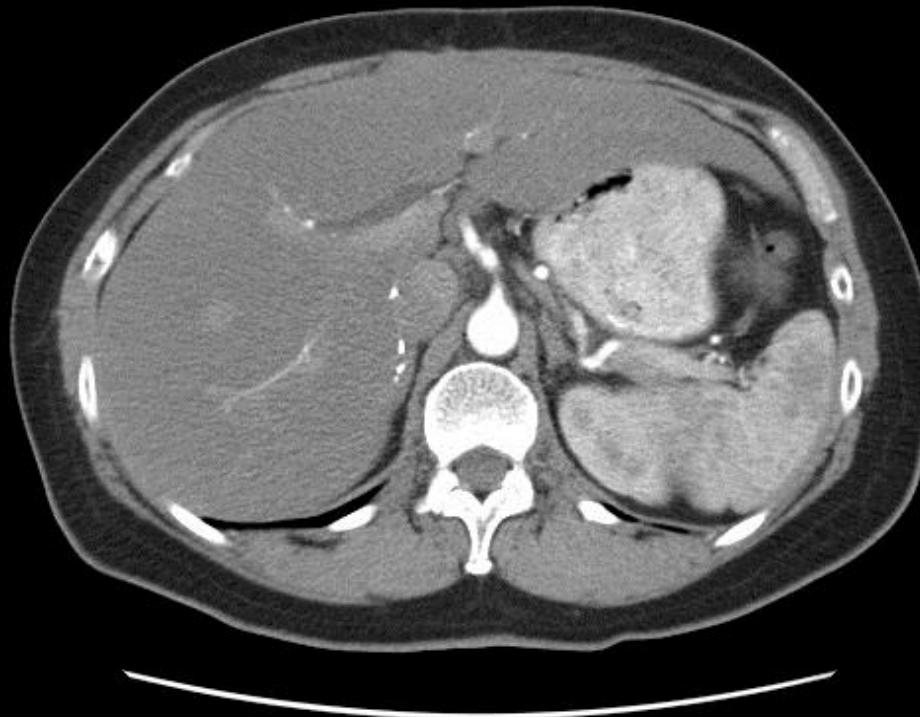
Arterial Phase (24 s Delay)



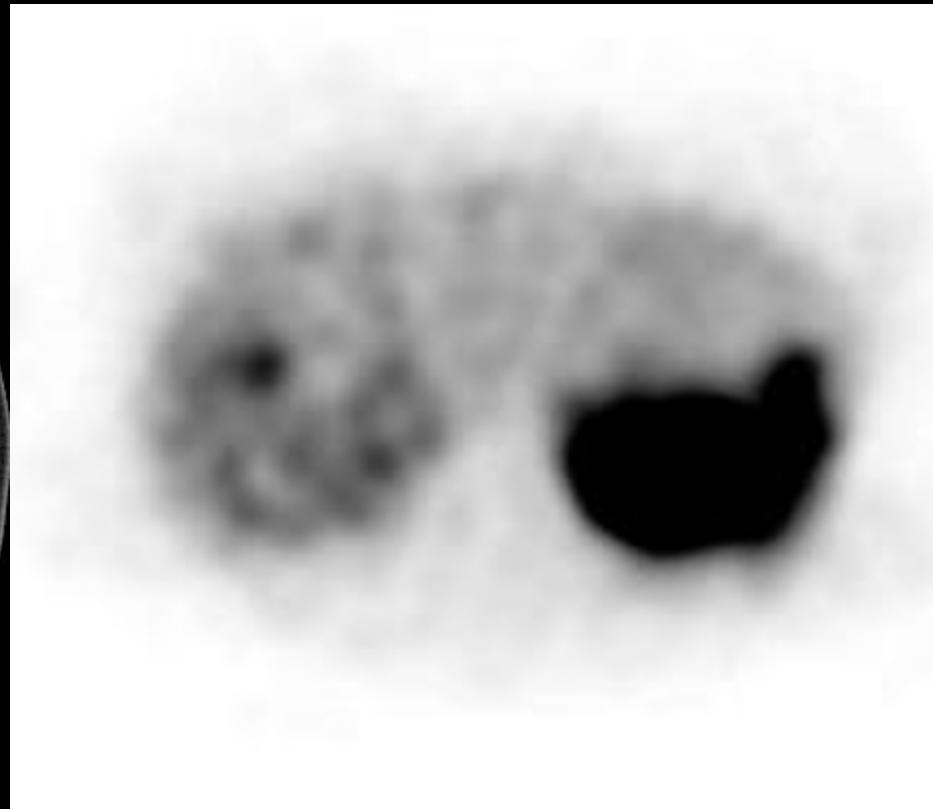
Portal venous Phase (40 s Delay)

CT – Lesion Detection in the Liver

NET – liver metastasis



Arterial Phase (24 s Delay)



SRS, SPECT

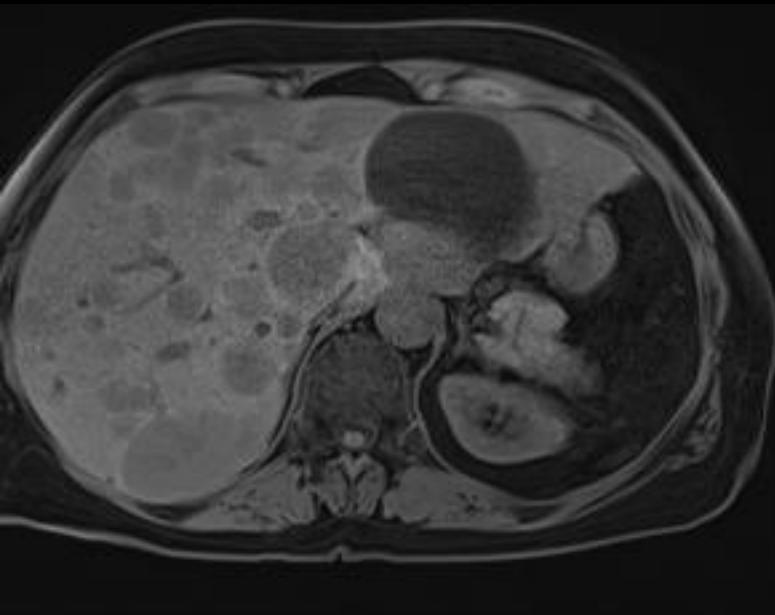
Rule out new lesions

Metaanalysis
Lesion based (CRC)

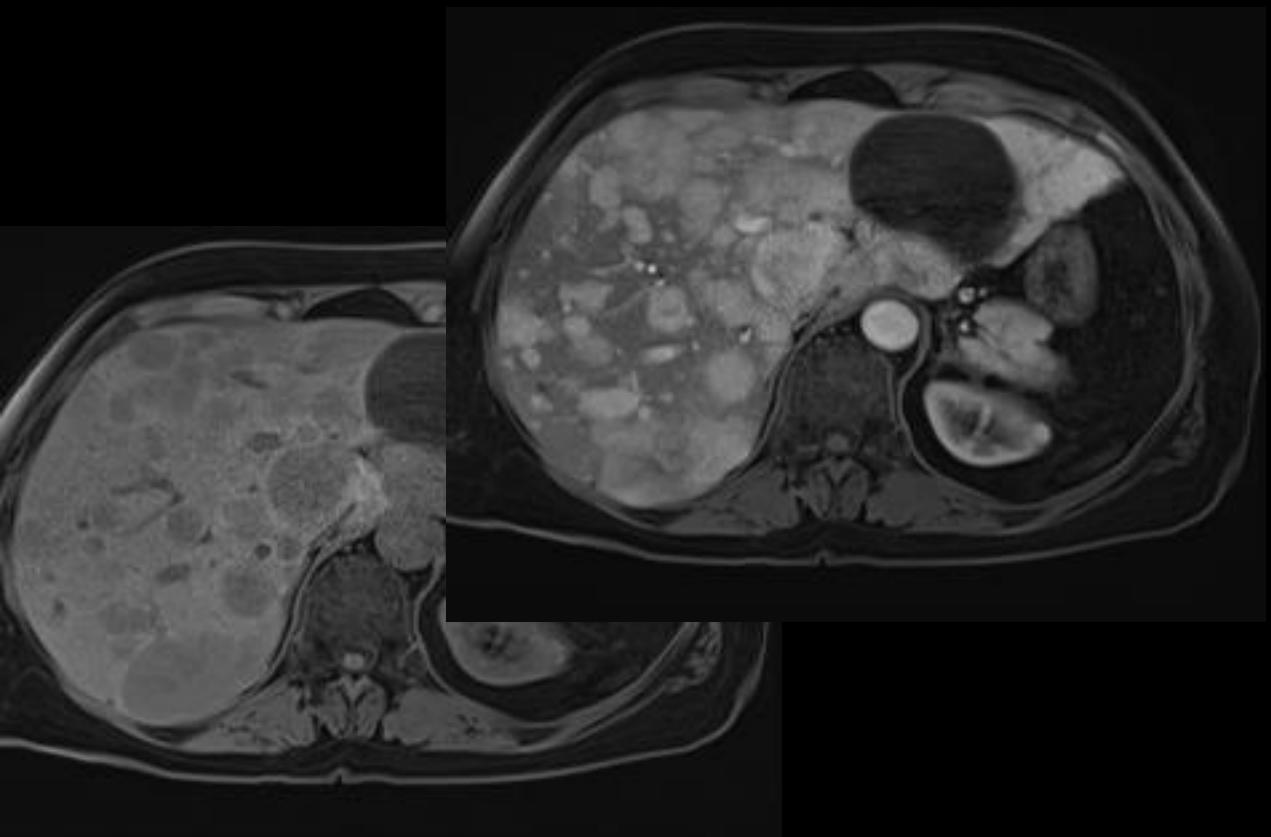
Subgroup	Mean Sensitivity (%)	
	MR Imaging	CT
Lesion size		
<1 cm	60.2 (54.4, 65.7) [n = 8]	47.3 (40.1, 54.5) [n = 5]
>1 cm	89.0 (81.7, 93.7) [n = 8]	86.7 (77.6, 92.5) [n = 5]
Study year		
Before January 2004	70.2 (63.2, 76.3) [n = 34]	73.4 (61.0, 83.0) [n = 20]
After January 2004	84.9 (79.3, 89.2) [n = 27]	74.9 (69.1, 79.9) [n = 18]

Nikel et al. Radiology 2010

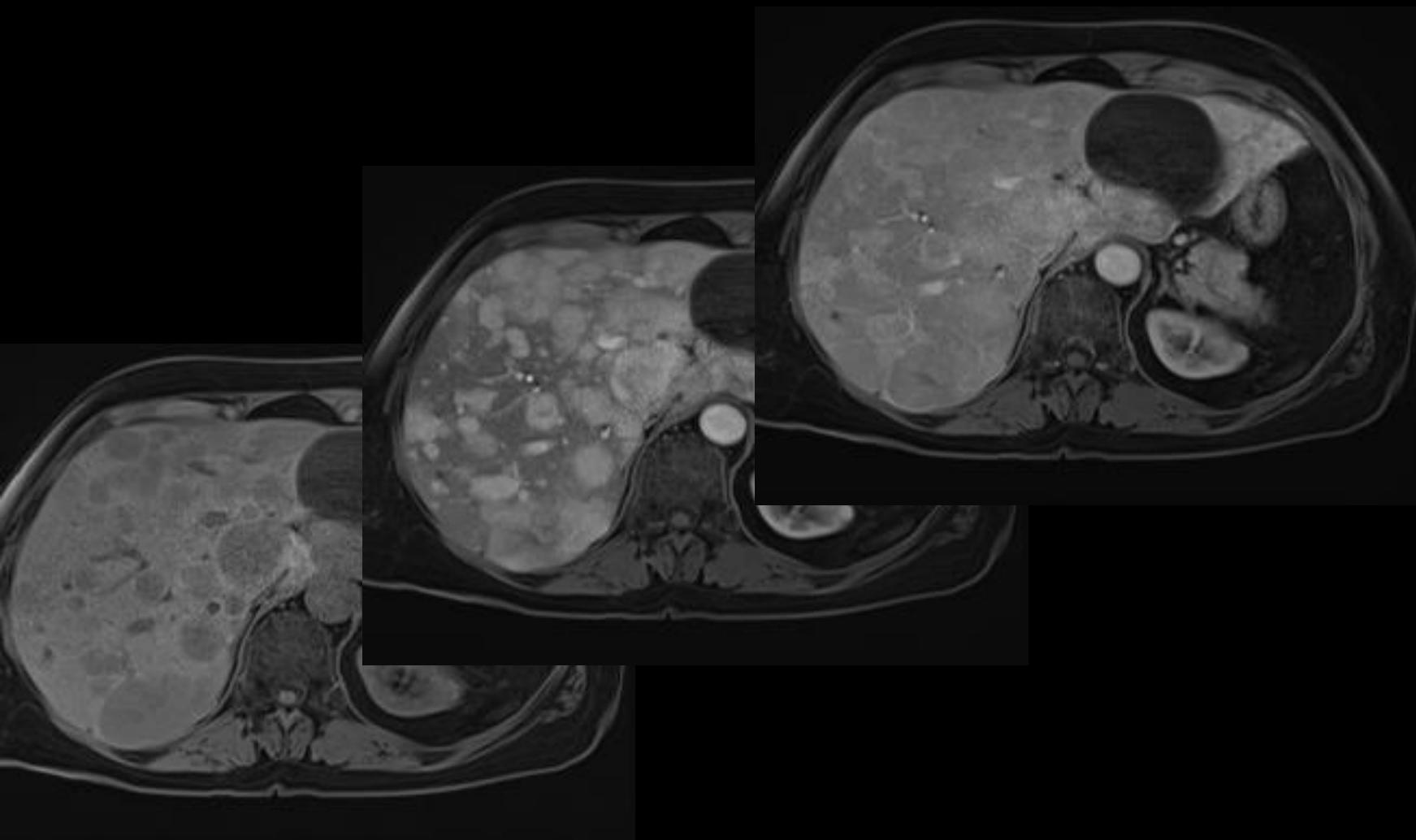
Use of liver specific CM – Gd-EOB Breathold T1w3DFS, 2 m Slices, 10 sec per liver



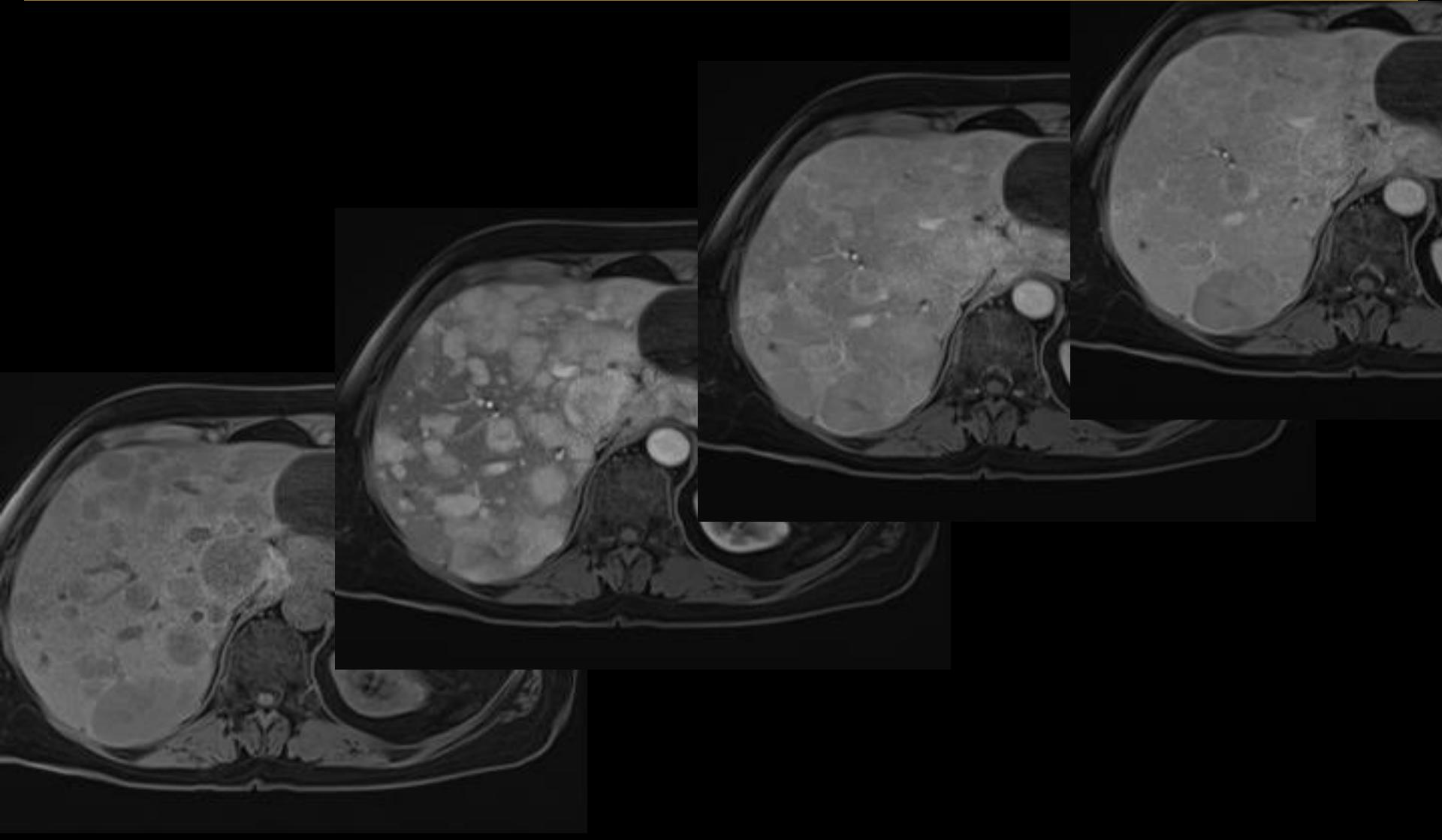
Use of liver specific CM – Gd-EOB Breathold T1w3DFS, 2 m Slices, 10 sec per liver



Use of liver specific CM – Gd-EOB Breathold T1w3DFS, 2 m Slices, 10 sec per liver

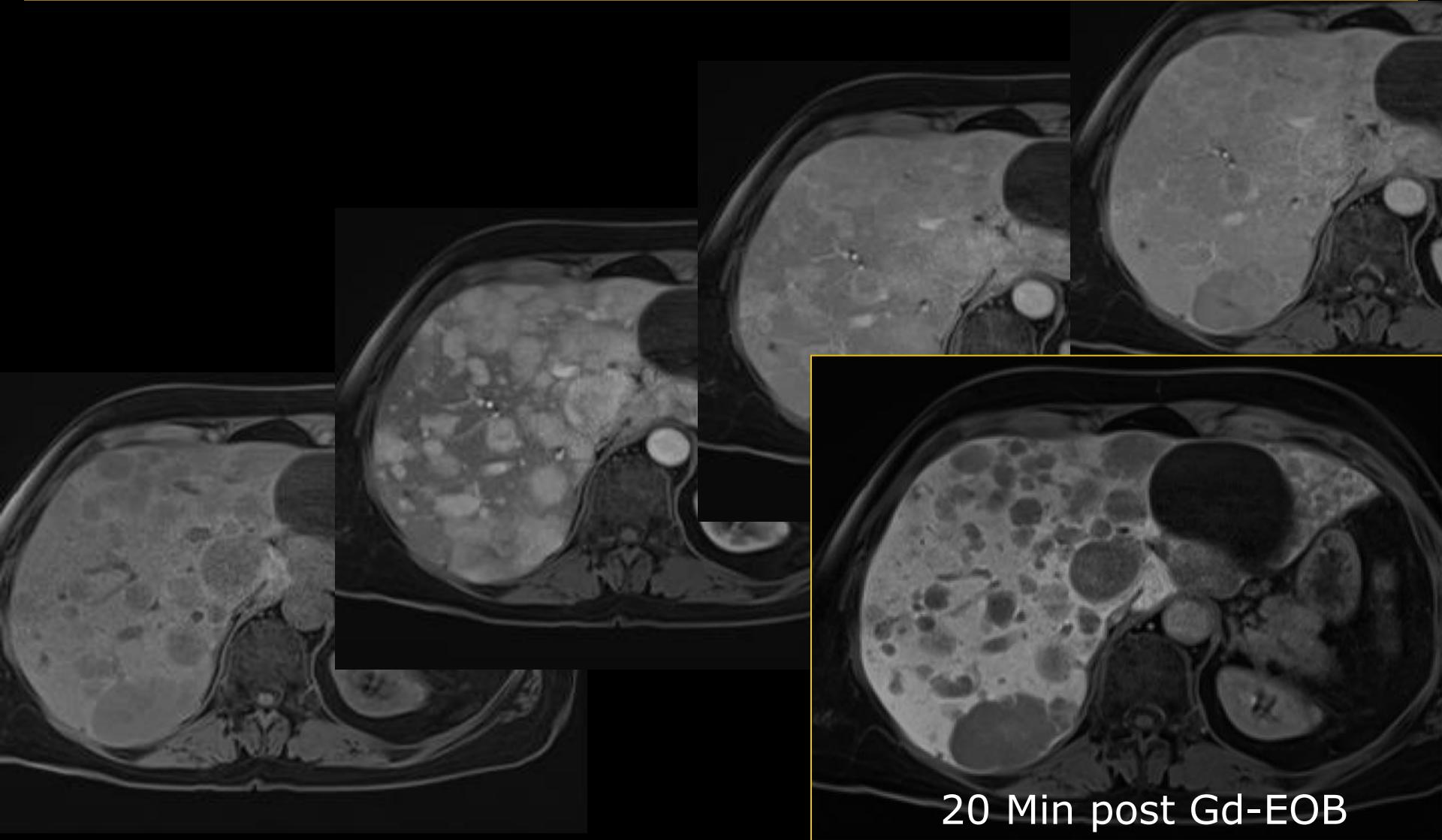


Use of liver specific CM – Gd-EOB Breathold T1w3DFS, 2 m Slices, 10 sec per liver



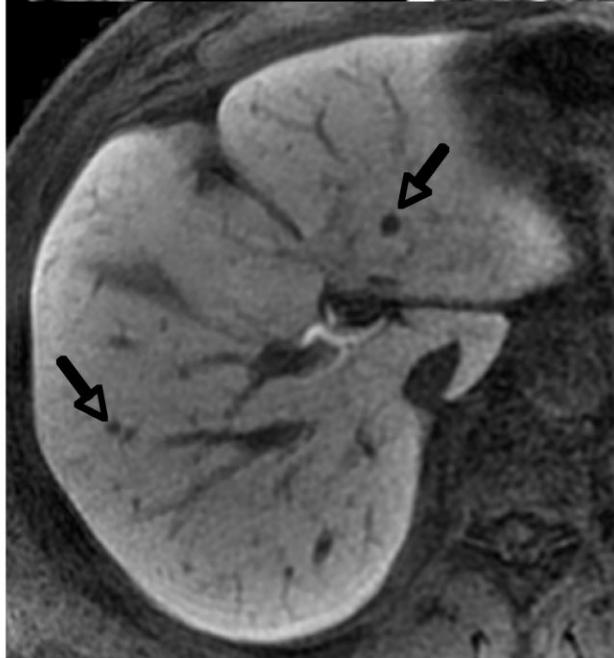
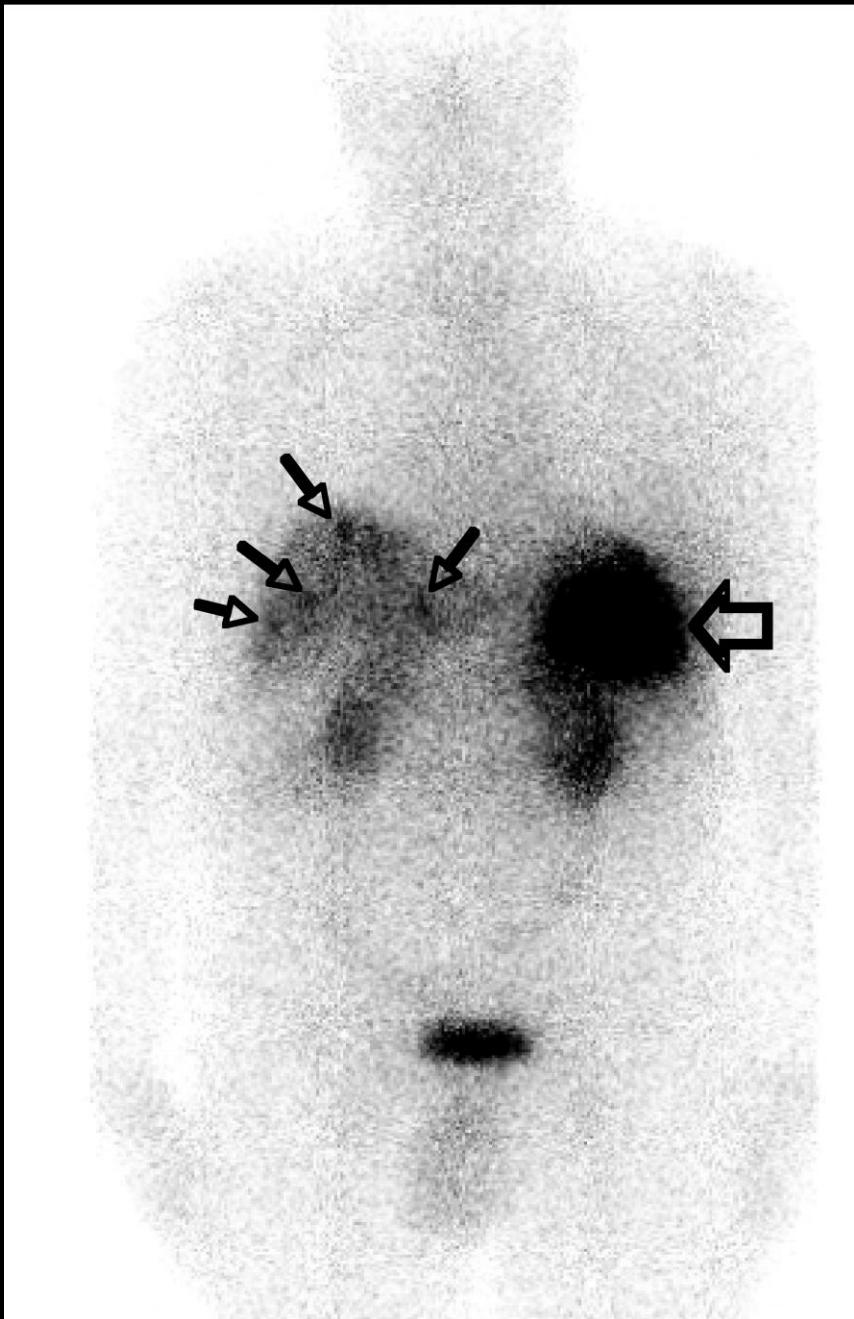
Use of liver specific CM – Gd-EOB

Breathold T1w3DFS, 2 m Slices, 10 sec per liver



20 Min post Gd-EOB

NET



Detection / Characterisation of liver metastases

	n	detection rate	correct characterization
Huppertz et al. 2004	302	MRI plain	81%
		EOB	87%
Bluemke et al. 2005	316	Biphasic CT	66%
		MR plain	63%
		EOB	71%
			71%

What if...?

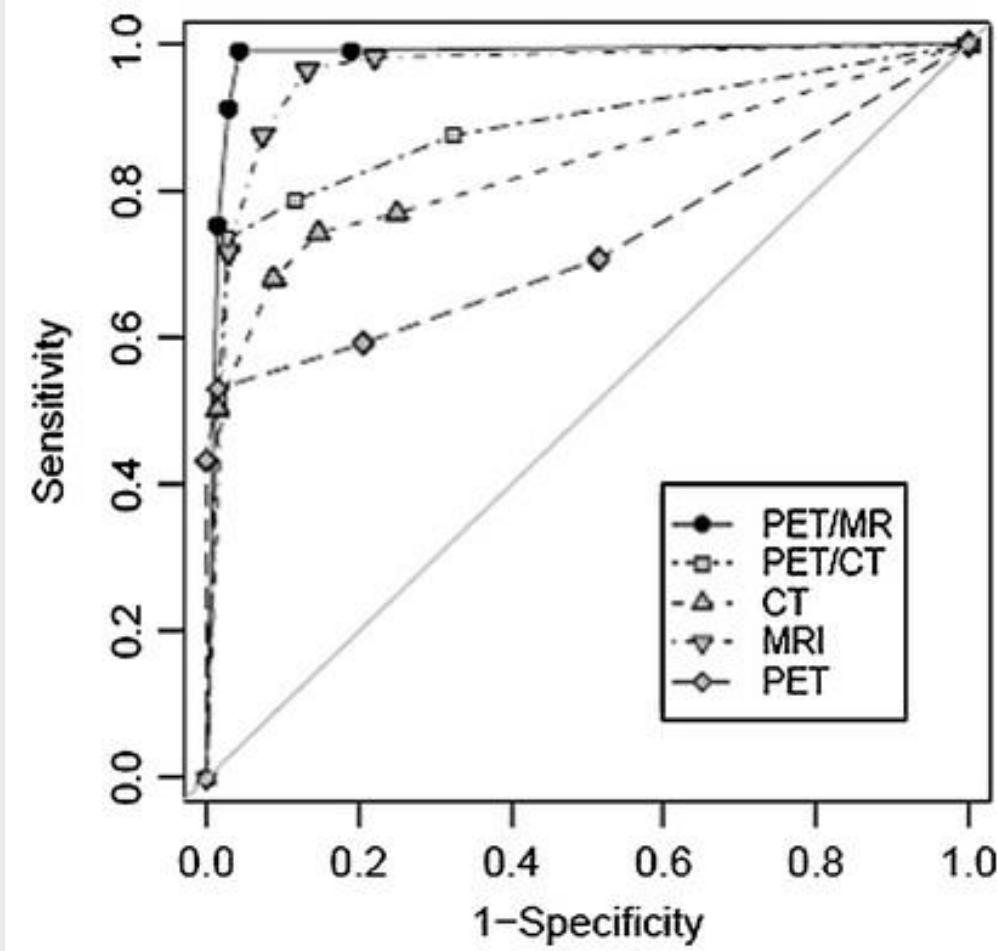
PET-MRI with EOB in NET – Retrospective Image Fusion

EOB-MRI

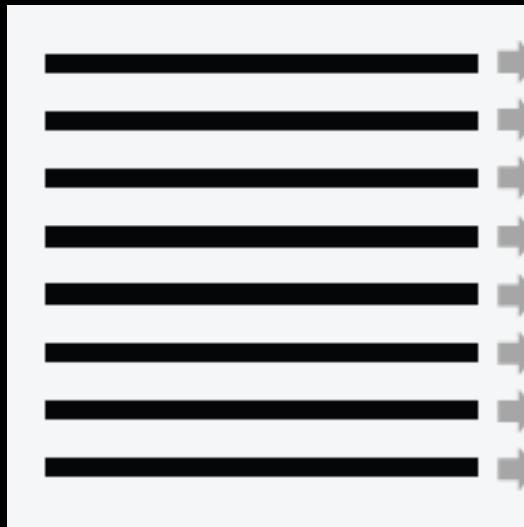
vs.

SR-PET-CT

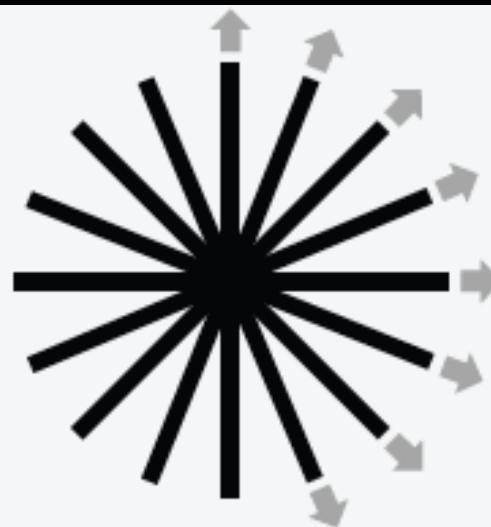
N=22 pts.



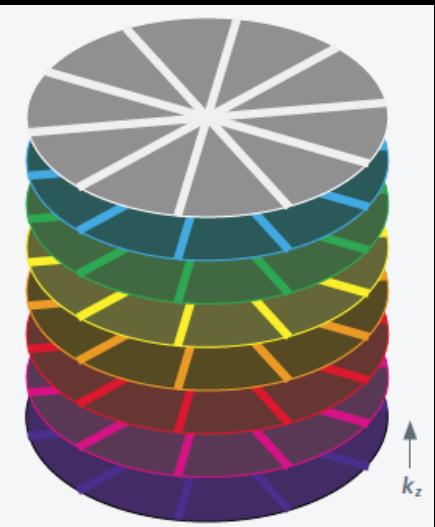
Radial-3DT1FS, free breathing, 1 mm Slices, 2-3 Min, hepatobiliary Plateau-phase of EOB



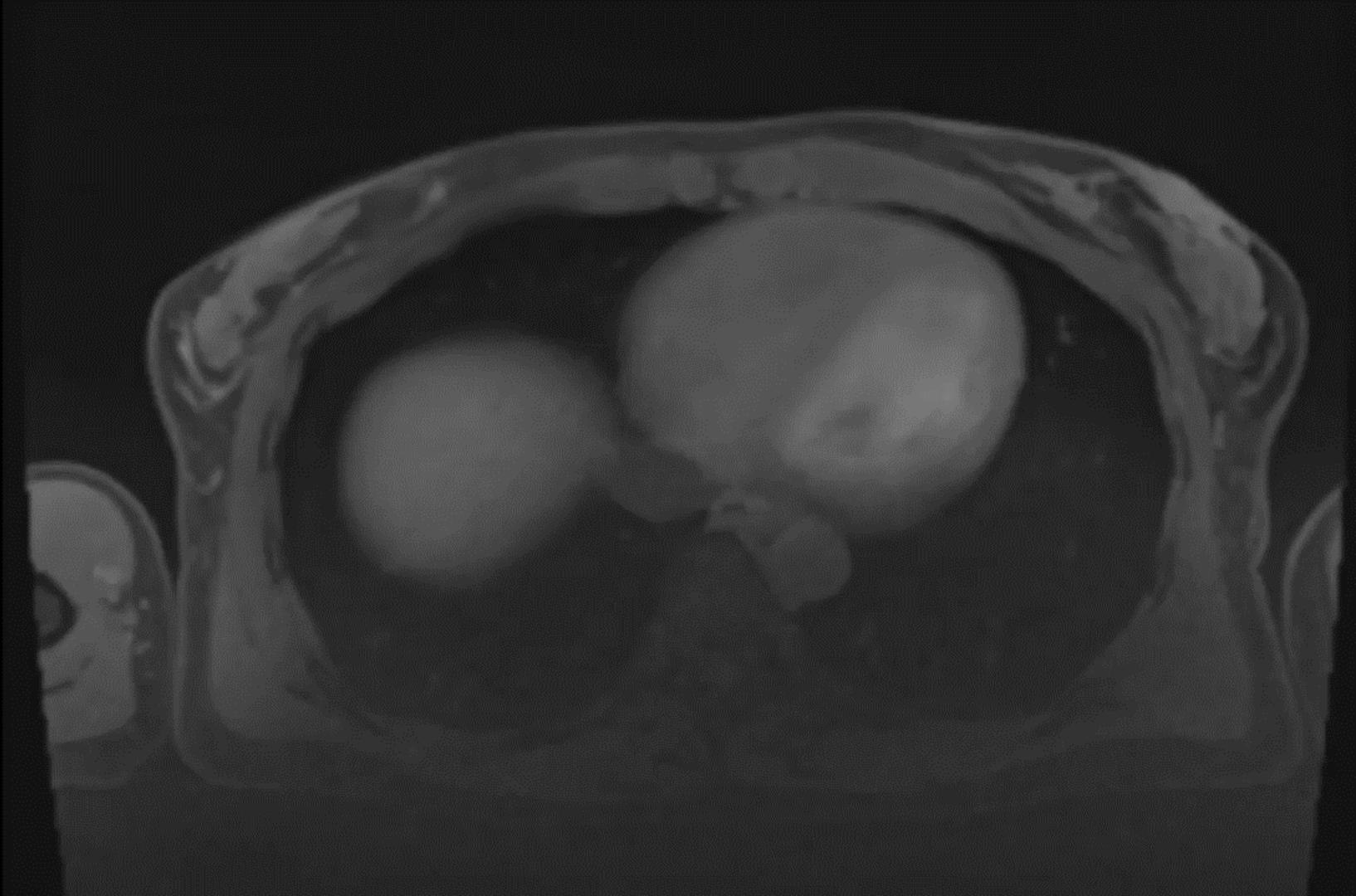
Kartesian k-space
breathold



Radial k-space
Free breathing



Radial-3DT1FS, free breathing, 1 mm Slices, 2-3 Min,



Response Evaluation in Diagnostic Imaging:

Demands:

- Robust
- Quantifiable
- Reproducible
- Early prediction

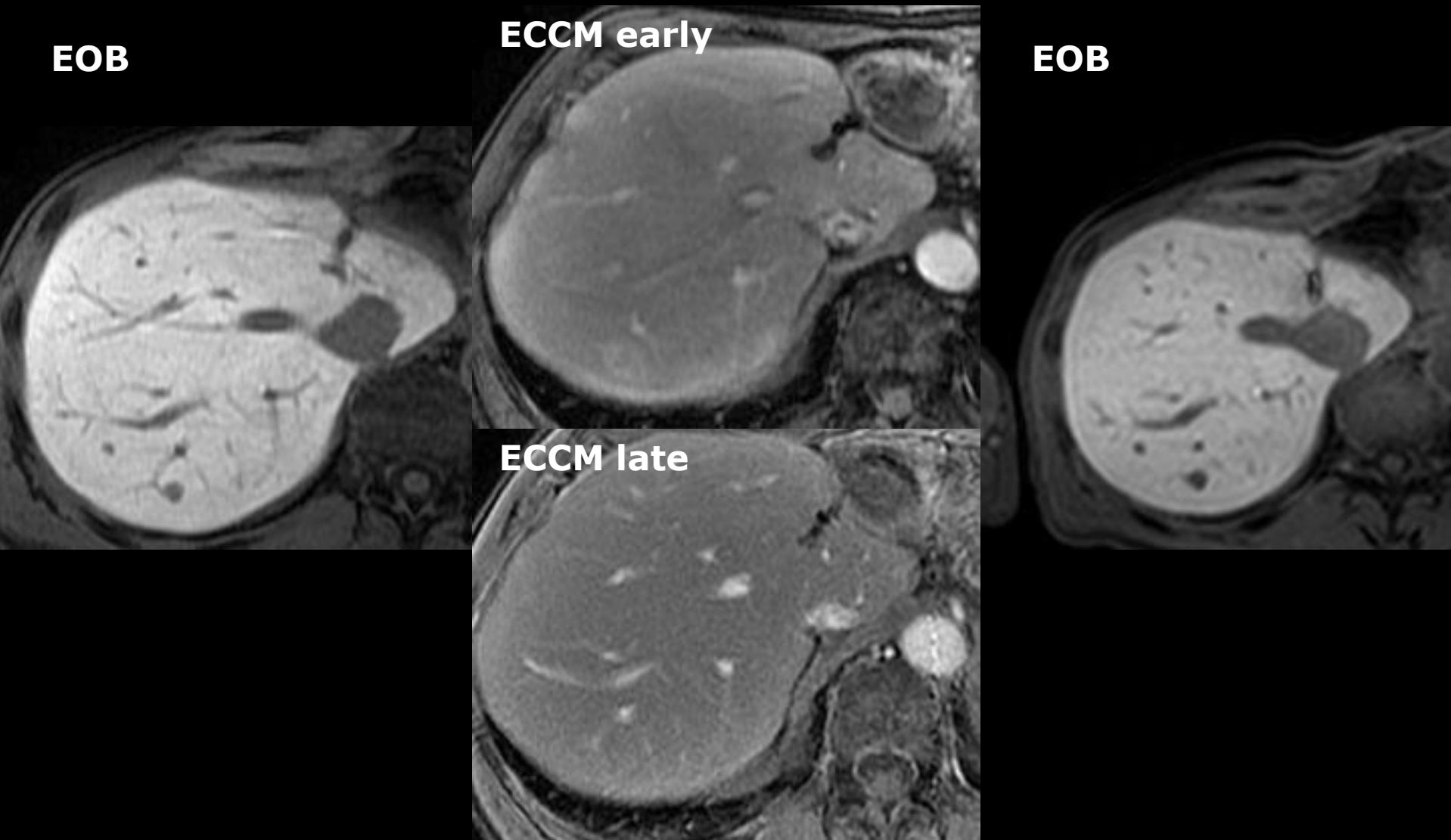
Methods:

- WHO
- **RECIST**
- mRECIST
- EASL, QEASL
- Special criteria (e.g. Choi, Immune related)
- TNI (MD Anderson)
- DWI
- Perfusion

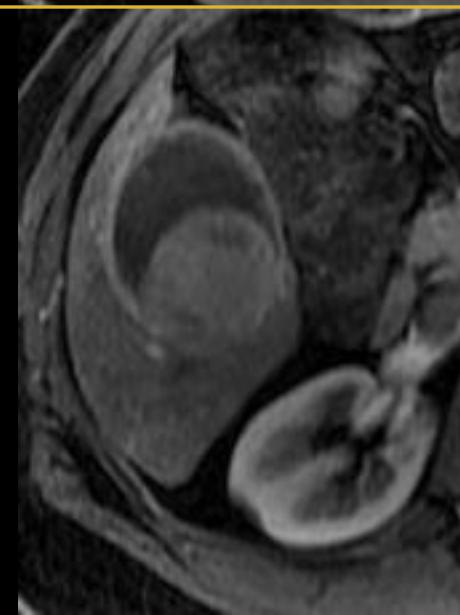
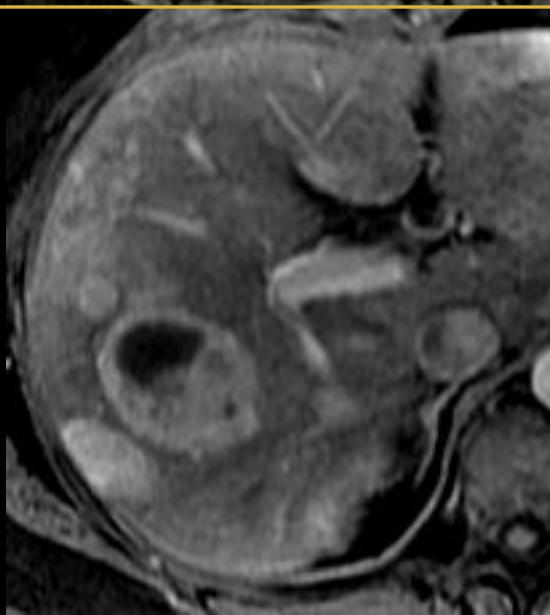
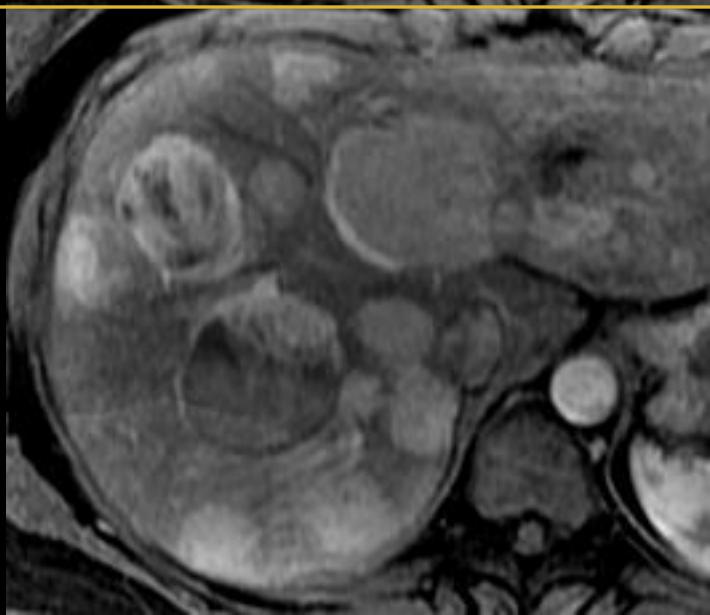
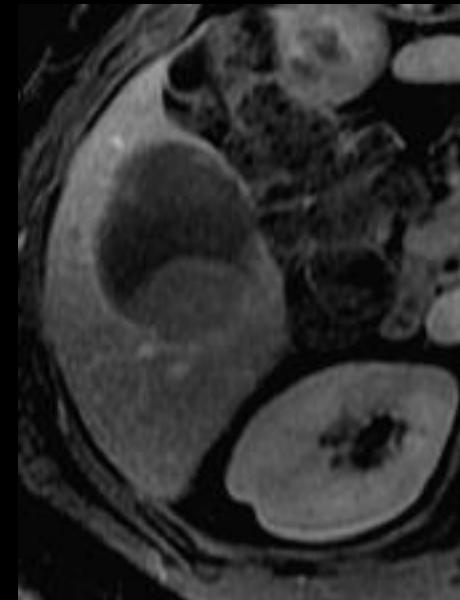
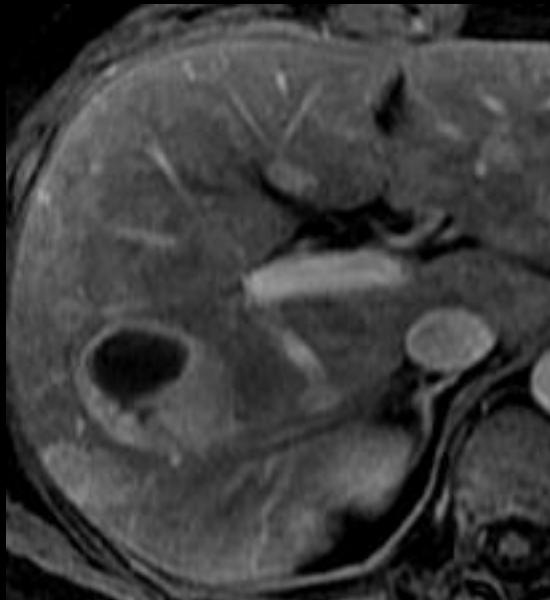
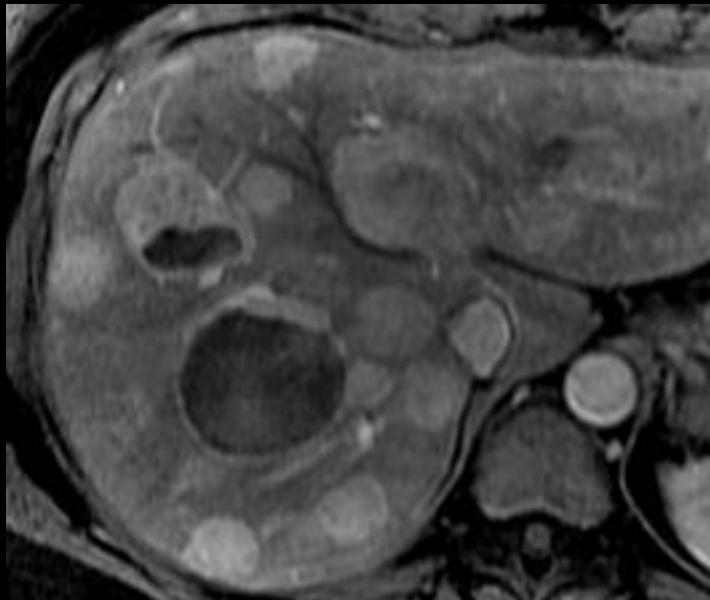
Limitations:

- Bias through
 - Imaging technique
 - CM-Delay
- Different tissue reactions depending on tumor type and differentiation, time, therapeutic agent

MRT – Therapy control under SSA



MRI – Follow-up after STOP Everolimus



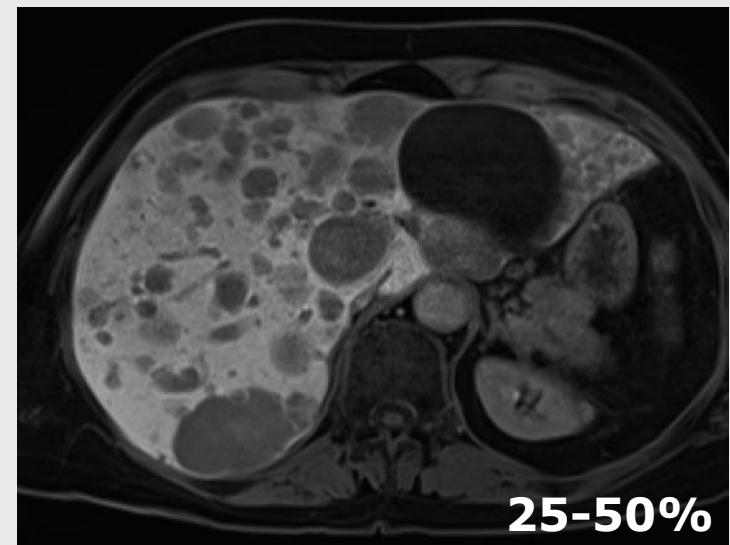
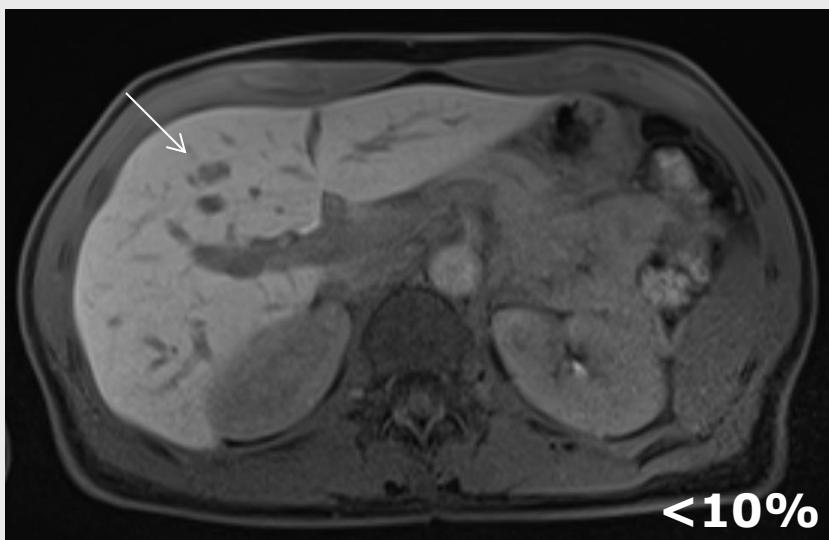
Prognosis: Hepatic Tumor Load

Prognostic factors: digNEN, n=62, (Uni-/Multivariate)

- Ki-67
- differentiation
- resection of primary
- **Hepatic tumor load**

Hentic et al. Neuroendocr Rel Cancer
2010

	WD group ^a	PD group ^a
Number of patients (n (%))	45 (71%)	18 (29%)
≤10%	21	1
10–25%	11	0
25–50%	9	9
>50%	4	8



Prognosis: Vascular Pattern

Non-functional pNET (G1/2) with liver metastases

N=44 w/o therapy other than SSA

Endpoint TTP

Denecke et al. Eur J Radiol 2014

	p-values
Hepatic tumor load	0.43 ¹
vascularization	0.51
Macrovessel infiltration	0.92
Regressive changes	0.35
Tumor-normal interface (TNI)	0.22

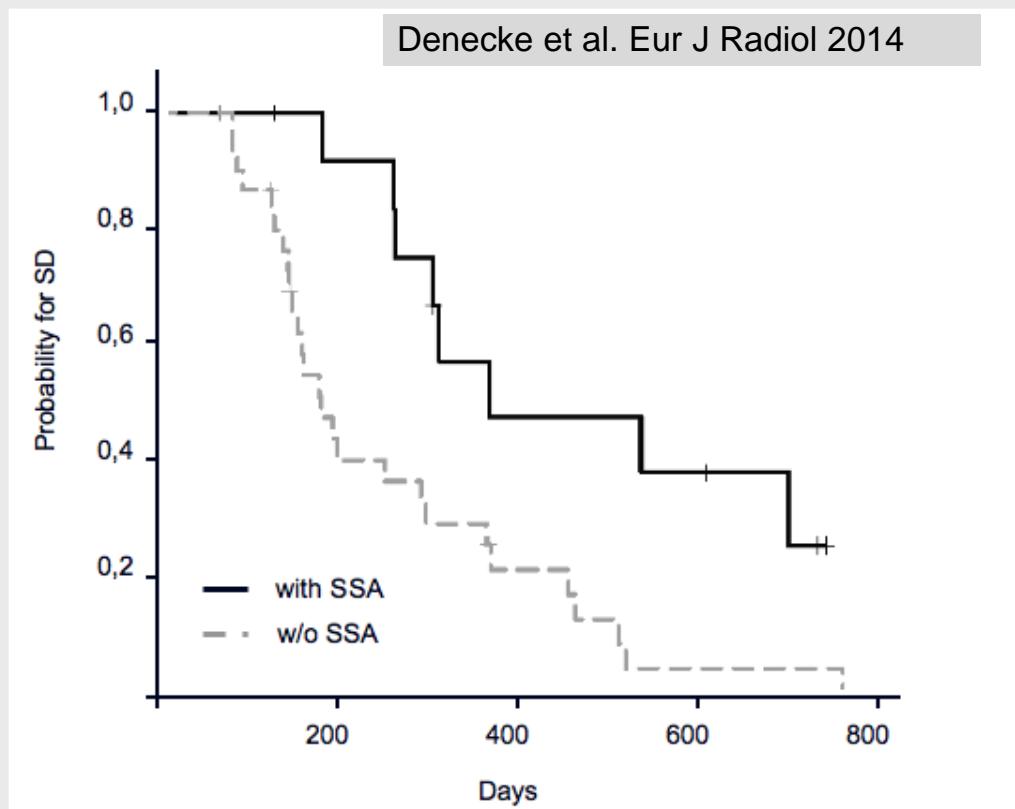
None significant

Prognosis: Vascular Pattern

- SSA associated with higher TTP ($p=0.01$)

With SSA: n=14
w/o SSA: n=30

- Mild antiproliferative effects of SSA can lead to disease stabilization¹



¹ PROMID, Rinke et al. J Clin Oncol 2009; Modlin et al. Aliment. Pharacol Ther 2010

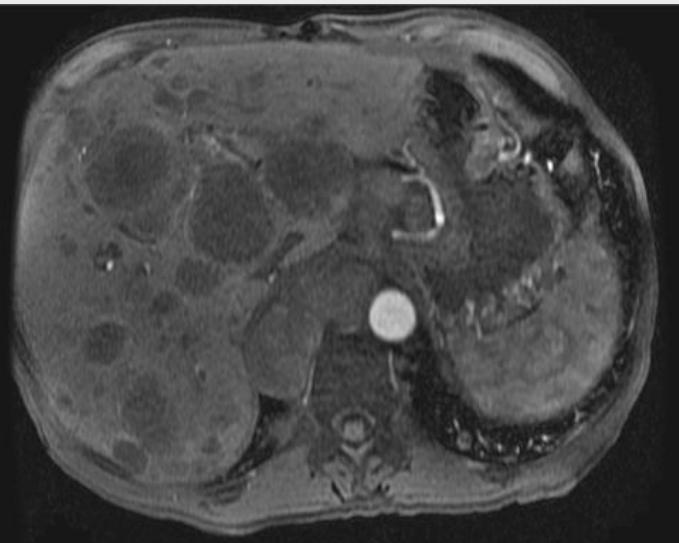
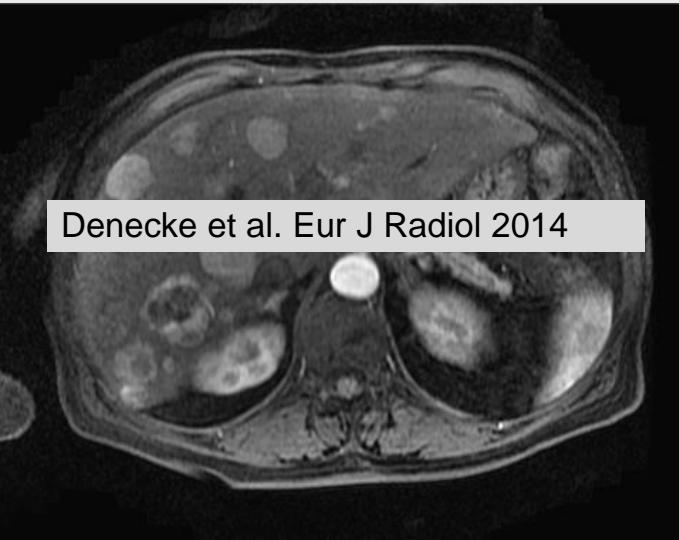
Vascular Pattern: indicator for early SSA in non-functional NET?

Hyper

w/o SSA
 $p=0.018$



Denecke et al. Eur J Radiol 2014



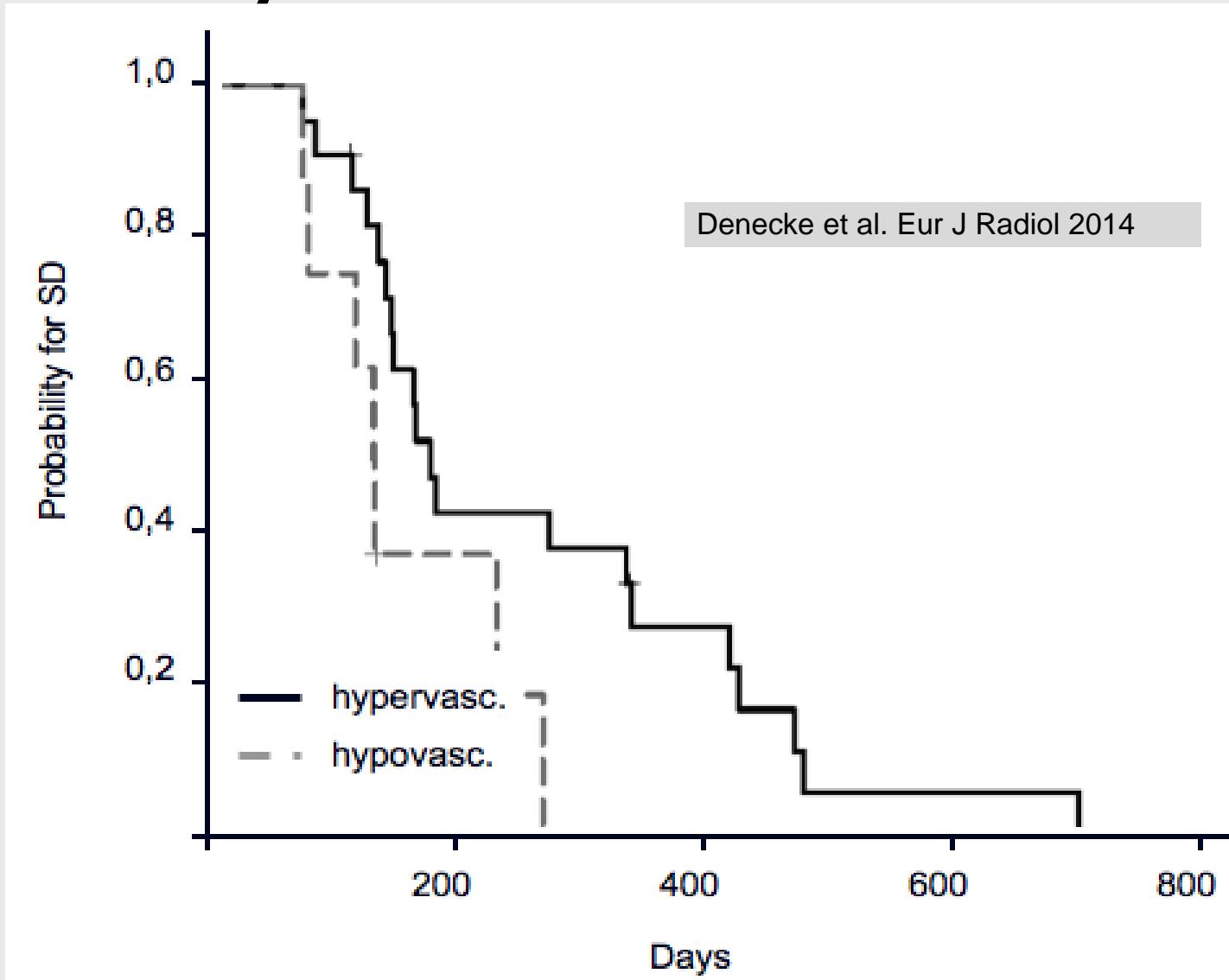
Hypo

Vascular Pattern: indicator for early SSA in non-functional NET?

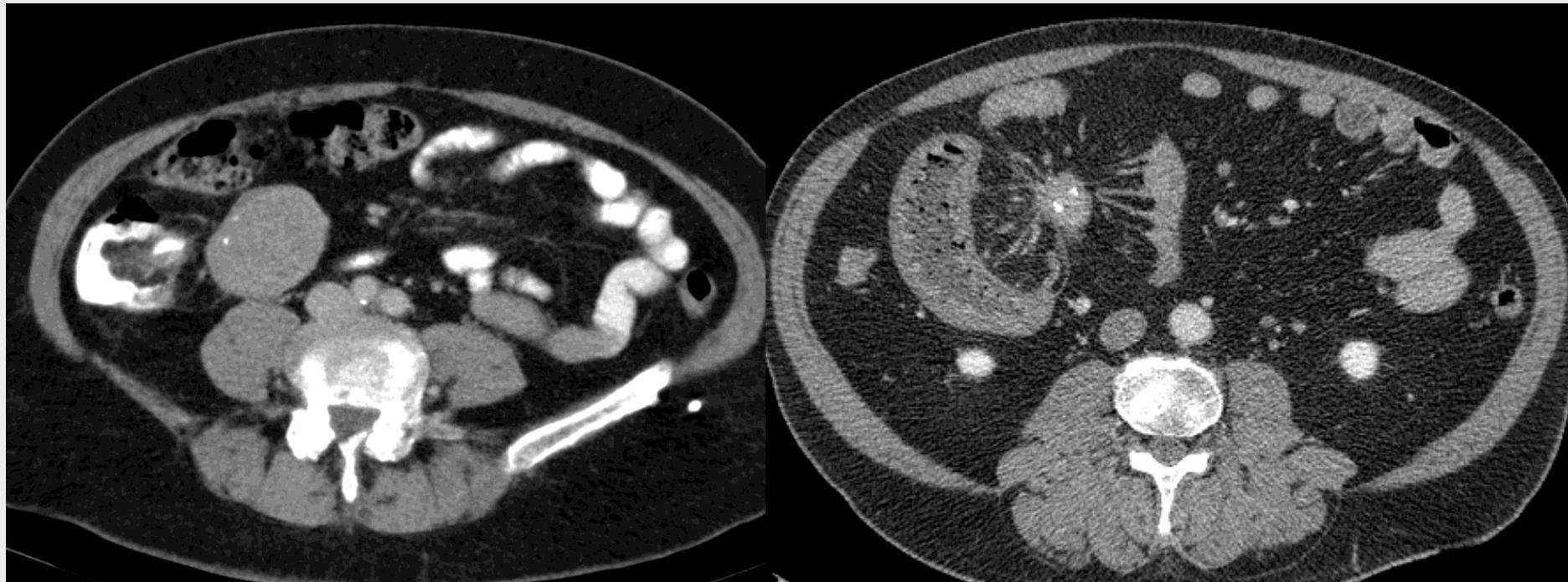
Hyper

w/o SSA
 $p=0.018$

Hypo



mesenterial Fibrosis around lymph node metastases

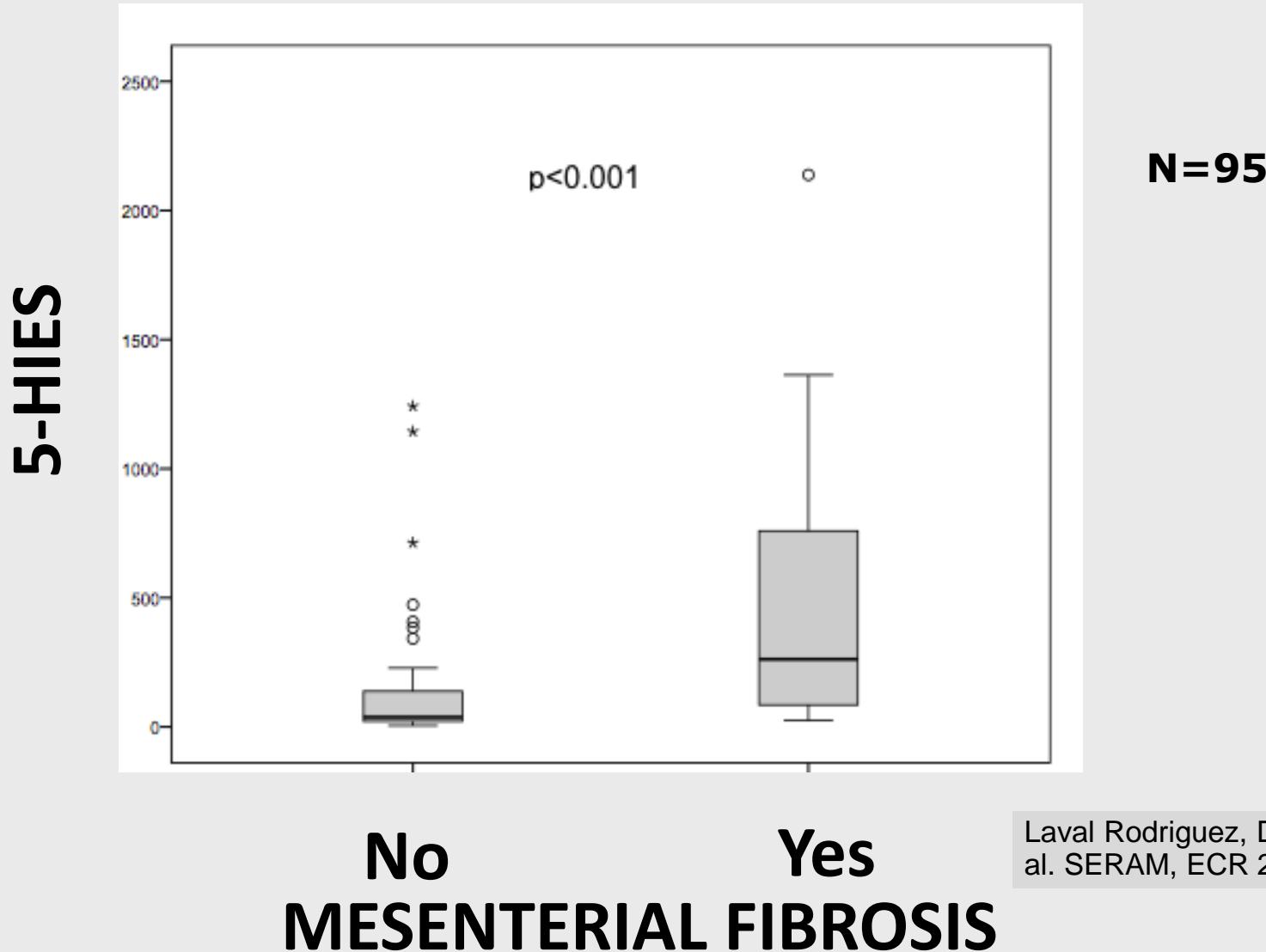


Clinical significance?

Link to metastatic pattern, vascular involvement, endocardial fibrosis?

37 µmol/d

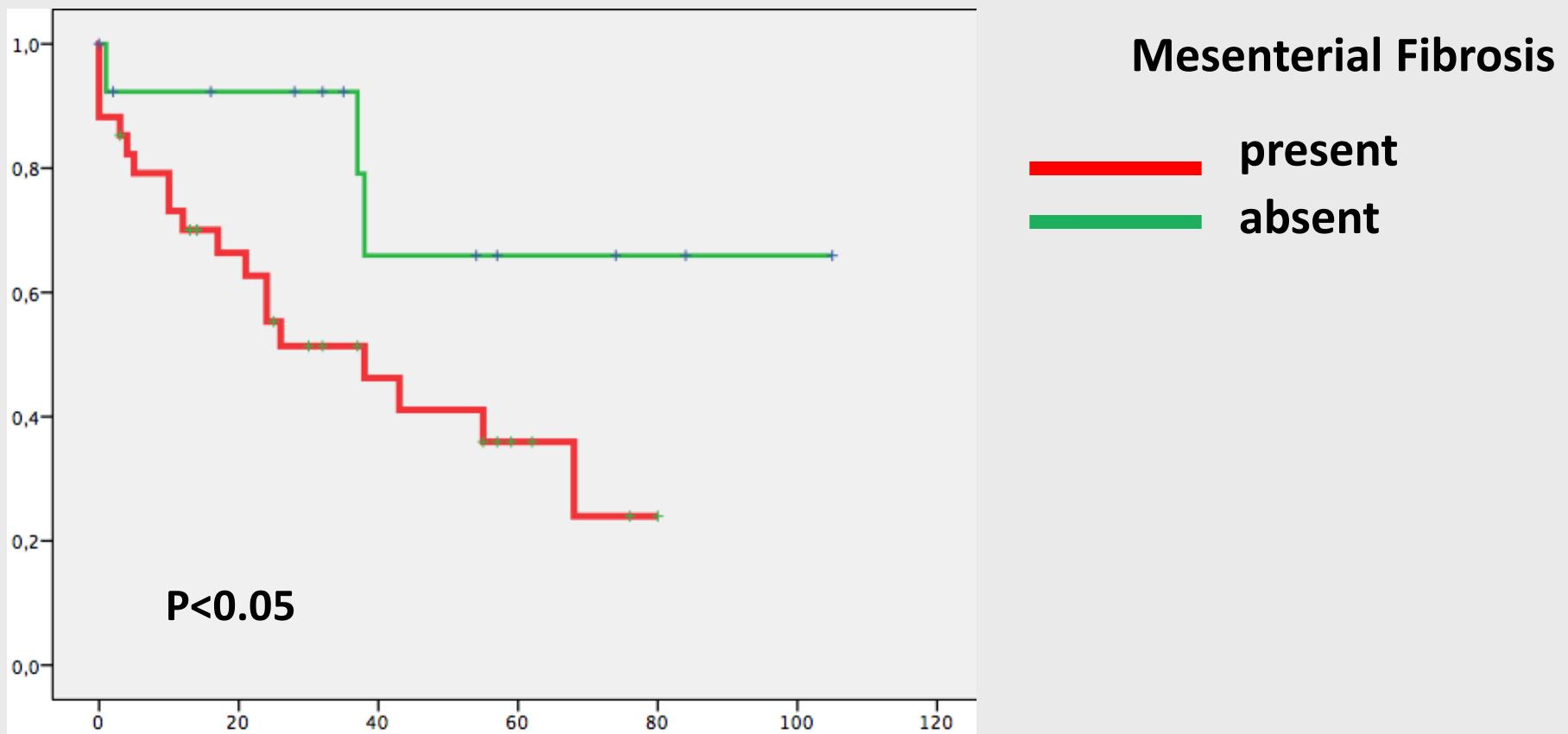
262 µmol/d



Laval Rodriguez, Denecke, Pavel et al. SERAM, ECR 2016

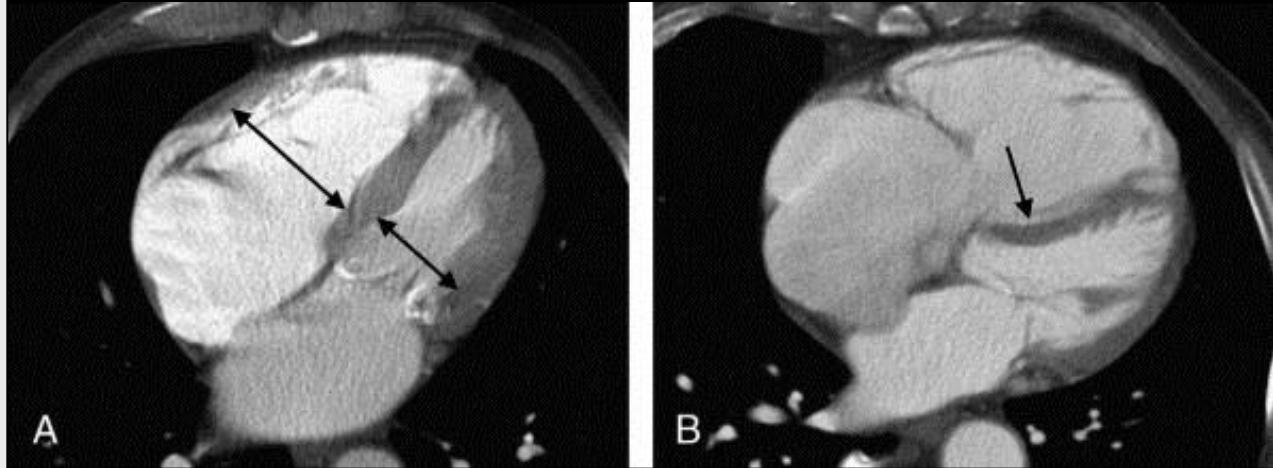
Carcinoid Heart Disease

Functional NET (n=32)

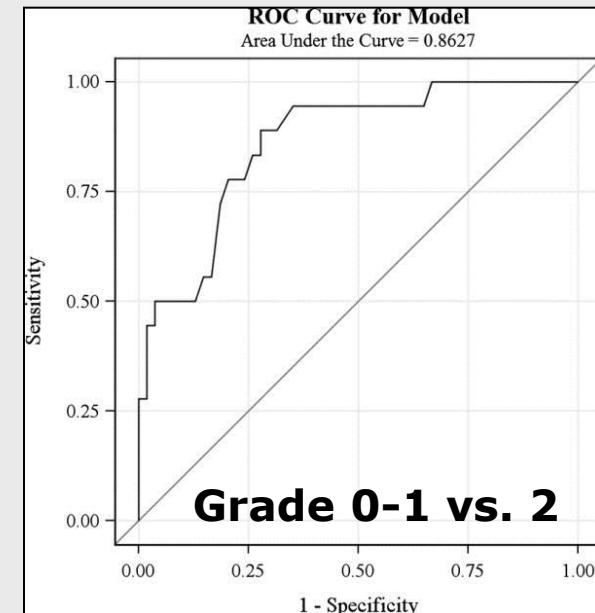
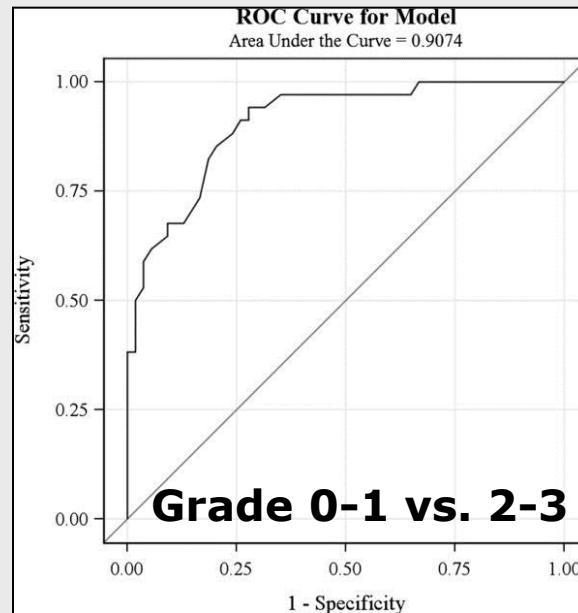


Indicators of Carcinoid Heart Disease on regular Staging CT in funct. NET

	Tricuspid Valve, n
Severity of valvular regurgitation	
0	11
1	16
2	9
3	8
Not explicitly reported	0



RV/LV-Ratio significant



Summary: NET Imaging Contribution of CT and MRI

Primary Tumor:

- Detection rate probably higher than published – Examination technique important, combination with SR-scans

Staging to the liver:

- Early contrast phases are essential for staging in CT & MRI
- MRI with liver specific agents: number, size – **Therapy control!!**

Add-ons:

- Hepatic tumor load, vascularity for prognosis
- indicators of carcinoid heart disease

Thank You !