Panel Discussion

Dedicated Prostate Cancer Imaging

@MashhadNucMed

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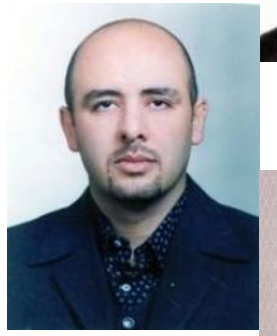
Mashhad University of Medical Sciences

NMRC
NUCLEAR MEDICINE RESEARCH CENTER
MASHHAD UNIVERSITY OF MEDICAL SCIENCES

Co-hosts of this panel

- ***Ali Taghizadeh**, MD [Radiation Oncologist]*
- ***Atena Aghaei**, MD [Nuclear Medicine]*
- ***Hamidreza Ghorbani**, MD [Urologist]*
- ***S. Jamalodin Tahsildar Tehrani**, MD [Radiologist]*
- ***Somayeh Barashki**, MD [Nuclear Medicine]*




Participate in uro-oncology tumor board meetings

Murphy, BJU 2019

Case #1

A 65-year-old patient presents with lower urinary tract symptoms (**LUTS**). His **prostate volume** is measured at **70 cc**, with a **total PSA** level of **5 ng/mL** and free PSA (**fPSA**) of **1 ng/mL**. During transurethral resection of the prostate (**TURP**), he was **incidentally diagnosed** with prostate cancer, with a **Gleason score of 3+3**.

a) Calculations of **PSA-D** and **fPSA/tPSA ratio** (cutoff)?

b) Is this patient considered **low-risk prostate cancer**, and should he be managed with active surveillance?

Case #1 (Cont.)

ChatGPT

a) Calculations:

- PSA density **(PSA-D)** is calculated by dividing the serum PSA level by the prostate volume. In this case: 5 ng/mL ÷ 70 cc ≈ **0.0714 ng/mL/cc**.

- The free-to-total PSA ratio **(fPSA/tPSA)** is: 1 ÷ 5 = 0.2 or **20%**.

b) Given the Gleason score of 3+3, low PSA level, and favorable fPSA/tPSA ratio, this patient **likely falls into a low-risk category** according to NCCN and EAU guidelines. However, factors such as tumor volume, patient age, comorbidities, and patient preferences should also be considered when deciding on active surveillance versus definitive treatment.

Case #1 (Cont.)

Gemini

The management of **incidentally detected prostate cancer after TURP** for presumed BPH requires careful consideration of the pathological findings, PSA kinetics, and patient factors. While **low-risk disease can often be managed with active surveillance, further imaging with mpMRI and targeted biopsies are frequently indicated for intermediate and high-risk cancers to guide appropriate treatment.** PSA density and %fPSA can provide additional risk information. PSMA PET/CT is generally reserved for higher-risk cases or suspicion of metastatic disease. The management plan should be individualized based on a **multidisciplinary discussion** involving the urologist, pathologist, and radiologist, adhering to established clinical practice guidelines.

Case #1

The patient undergoes transrectal ultrasound-guided biopsy (**TRUS Bx**), which reveals **positive cores in 6 out of 12 samples**; one core shows a **cribriform pattern**. On physical examination, a palpable nodule is now detected.

a) Is the patient a **candidate for mpMRI or PSMA PET/CT**?

b) Significance of **cribriform pattern and intraductal carcinoma (IDC)**?

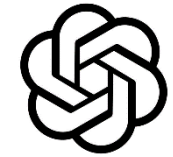
Pathological Predictors of PSMA PET Positivity by Anatomical Site

ECE (miT3a)	SVI (miT3b)	Pelvic Nodes (miN1/miN2)	Extrapelvic Nodes (miM1a)	Bone Metastasis (miM1b)	Visceral Metastasis (miM1c)
ISUP GG ≥3 >30% positive biopsy cores	ISUP GG ≥4 Bilateral multifocal disease	GS ≥7 ≥4 positive cores Cribriform Pattern IDC	Cribriform Pattern IDC	GS ≥7	Small cell/neuroendocrine component
[1, 2]	[3, 4]	[5-7]	[8, 9]	[10, 11]	[12, 13]

References:

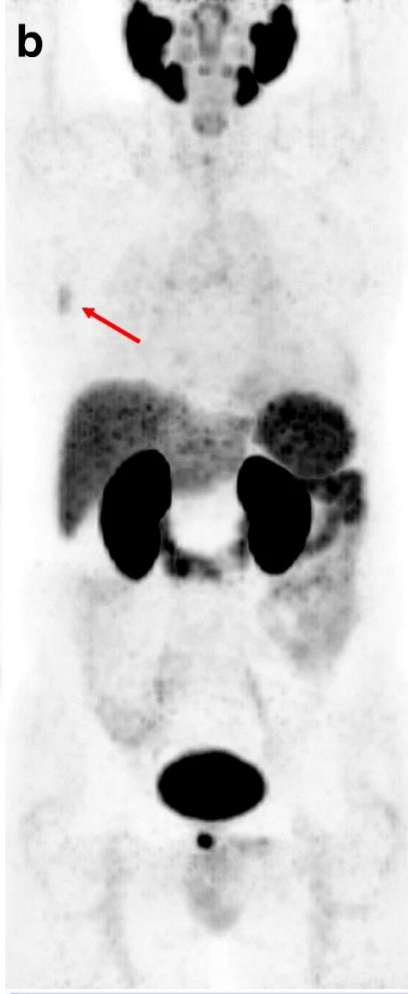
1. Spiegel, Insights Imaging 2024.
2. Roberts, Nat Rev Urol 2022.
3. Ceci, Eur Urol Oncol 2019.
4. Van Leeuwen, JNM 2023.
5. Trabulsi, Eur Urol 2022.
6. Trudel, Medscape 2025.
7. Fendler Eur Urol 2017.
8. Ceci, Cancers 2023.
9. Hofman, Lancet 2020.
10. Calais, JNM 2020.
11. Rauscher, JNM 2020.
12. Gu, EJNMMI 2025.
13. Dietlein, JNM 2020.

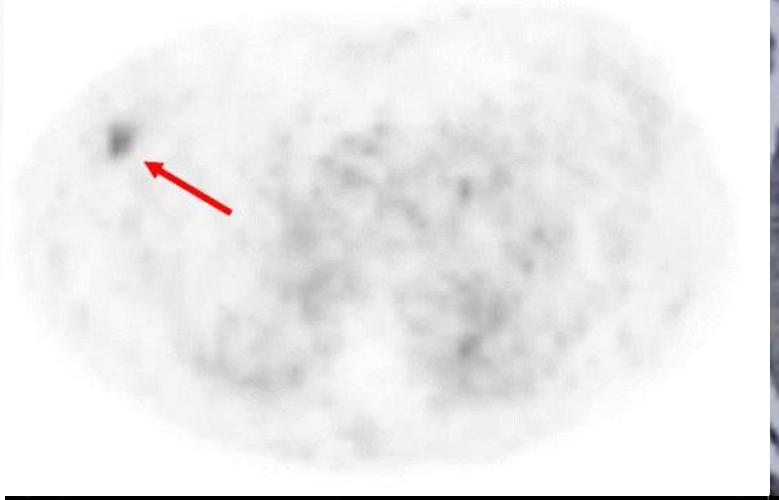
Gemini

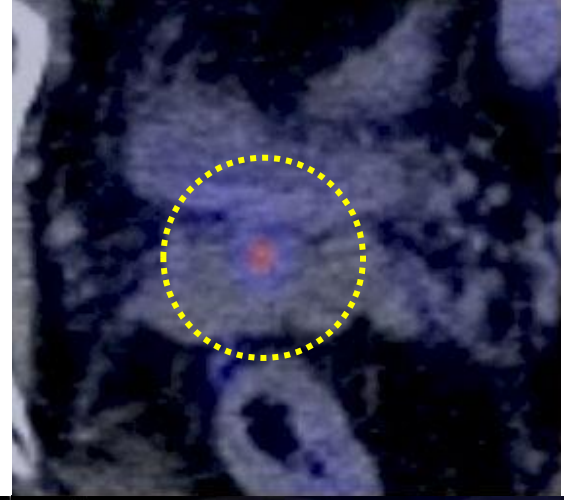


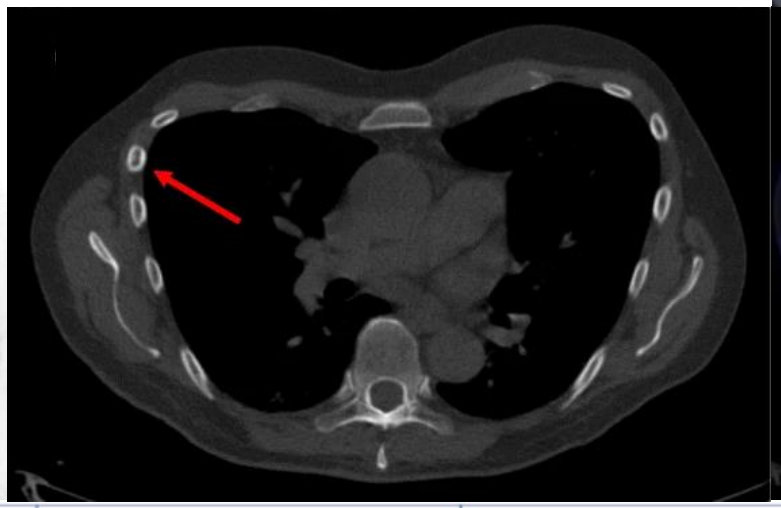
ChatGPT

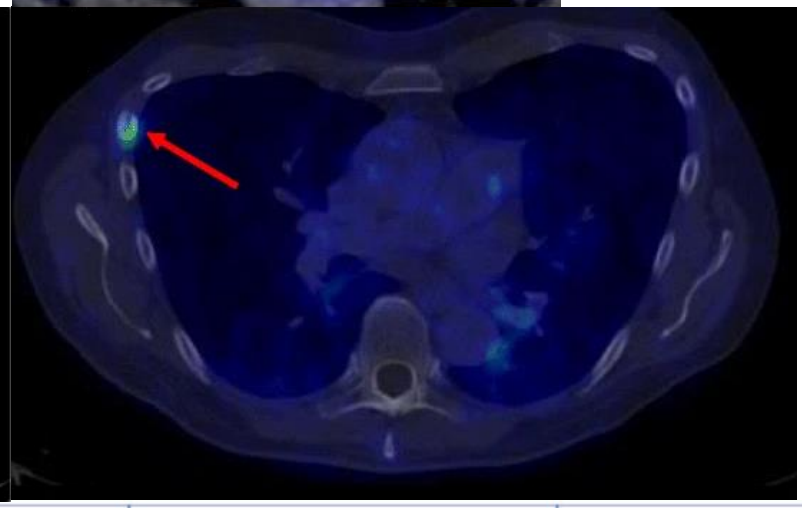
Case #1 (Cont.)



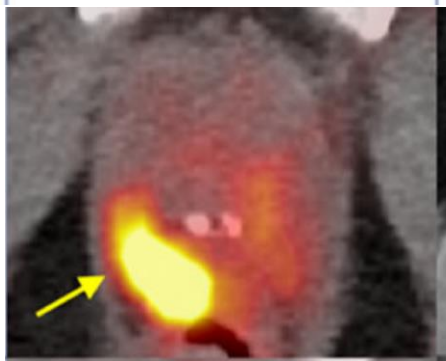


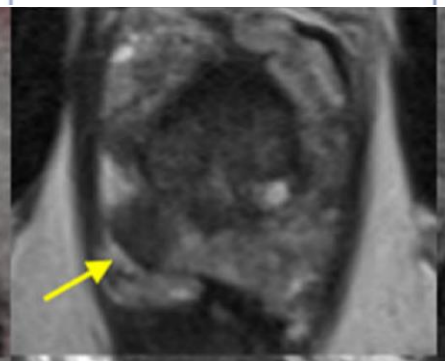


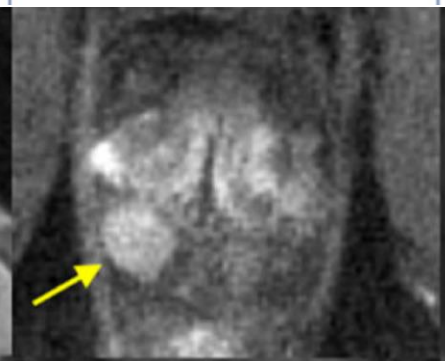


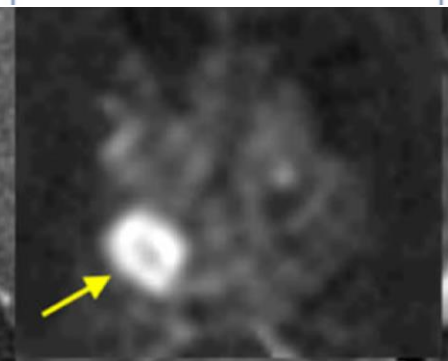


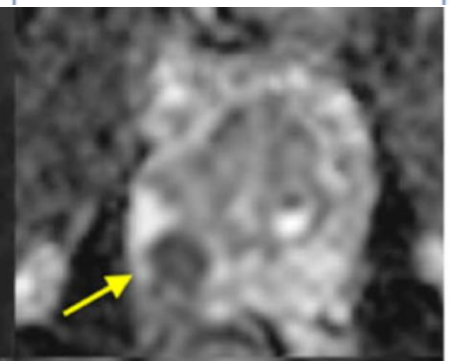
Fused PSMA-PET/CT	T2WI	DCE-MRI	DWI	ADC map











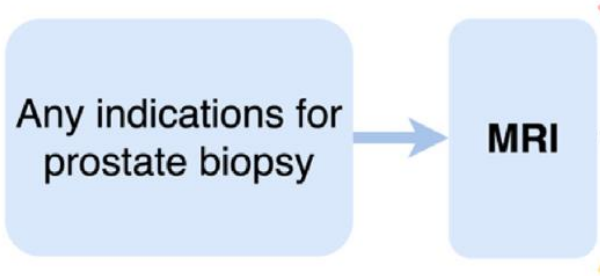
Case #1 (Cont.)

- **Predictors of EPE in mpMRI:**
  1. Breach of the capsule with **direct tumor extension** (OR: 15.57)
  2. Tumor-capsule **interface >10 mm** (OR: 10.47)
  3. **Asymmetry** or invasion of **neurovascular bundle** (OR: 7.58)
  4. **Obliteration of retroprostatic angle** (OR: 6.09)
  5. **Bulging** prostatic **contour** (OR: 5.54)
  6. **Irregular or spiculated margin** (OR: 2.29)

- **Pooled sensitivity: 55%**
- **Pooled specificity: 87%**

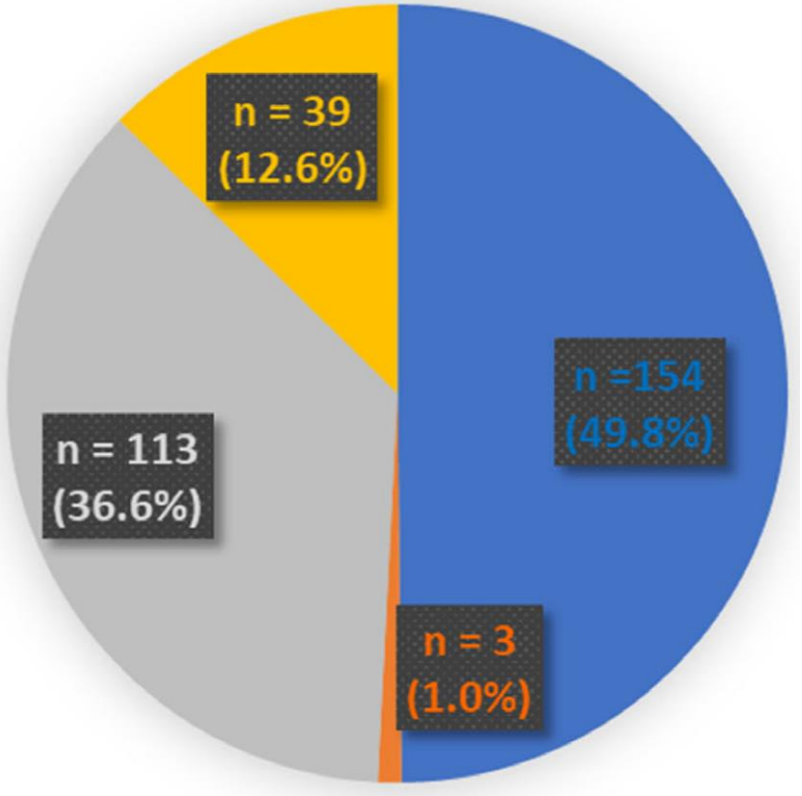
Choi, Insights to Imaging 2024
Zhang, Br J Radiol 2019

Case #1 (Cont.)

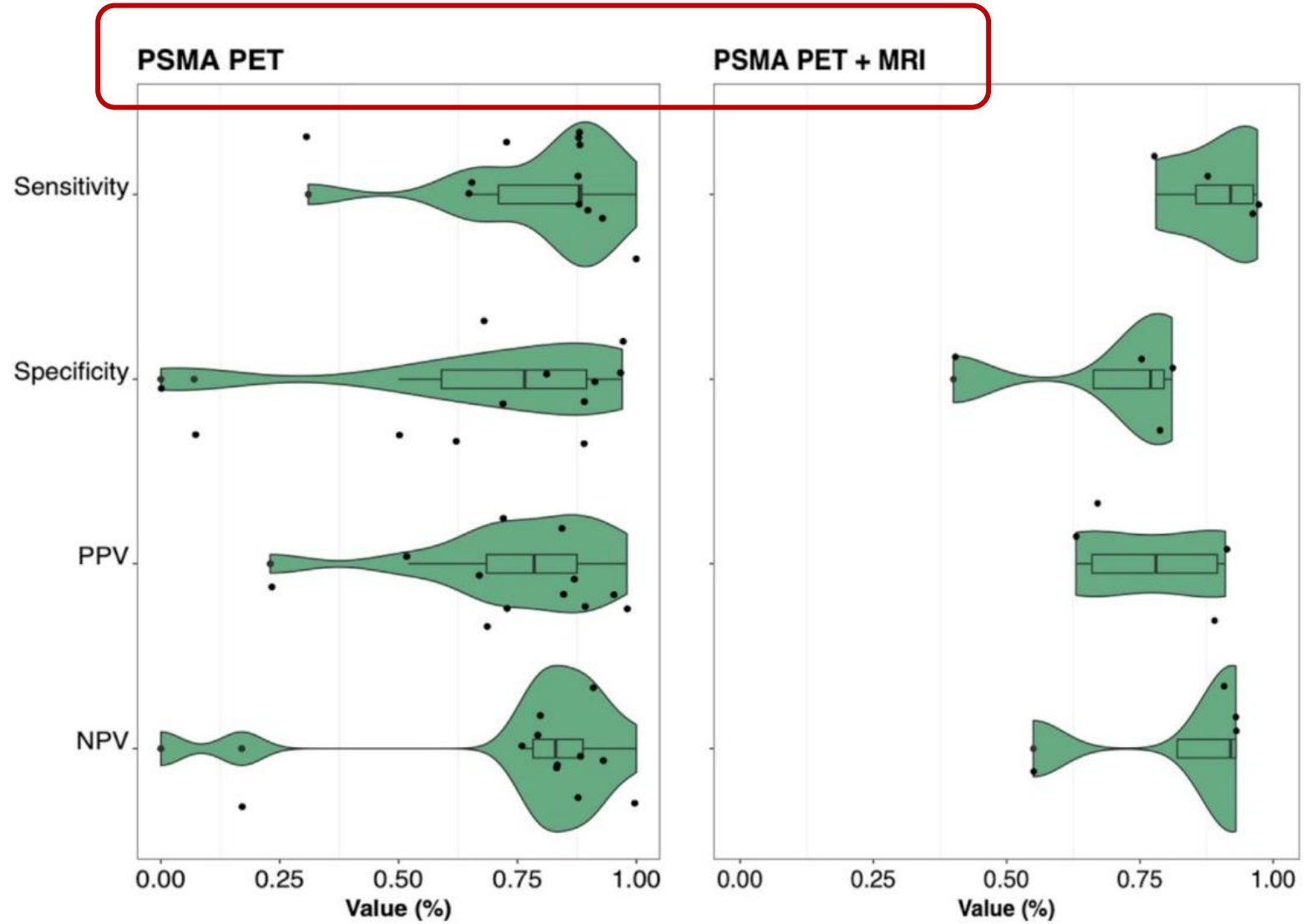


Wang, Eur Urol Oncol 2024

Case #1 (Cont.)

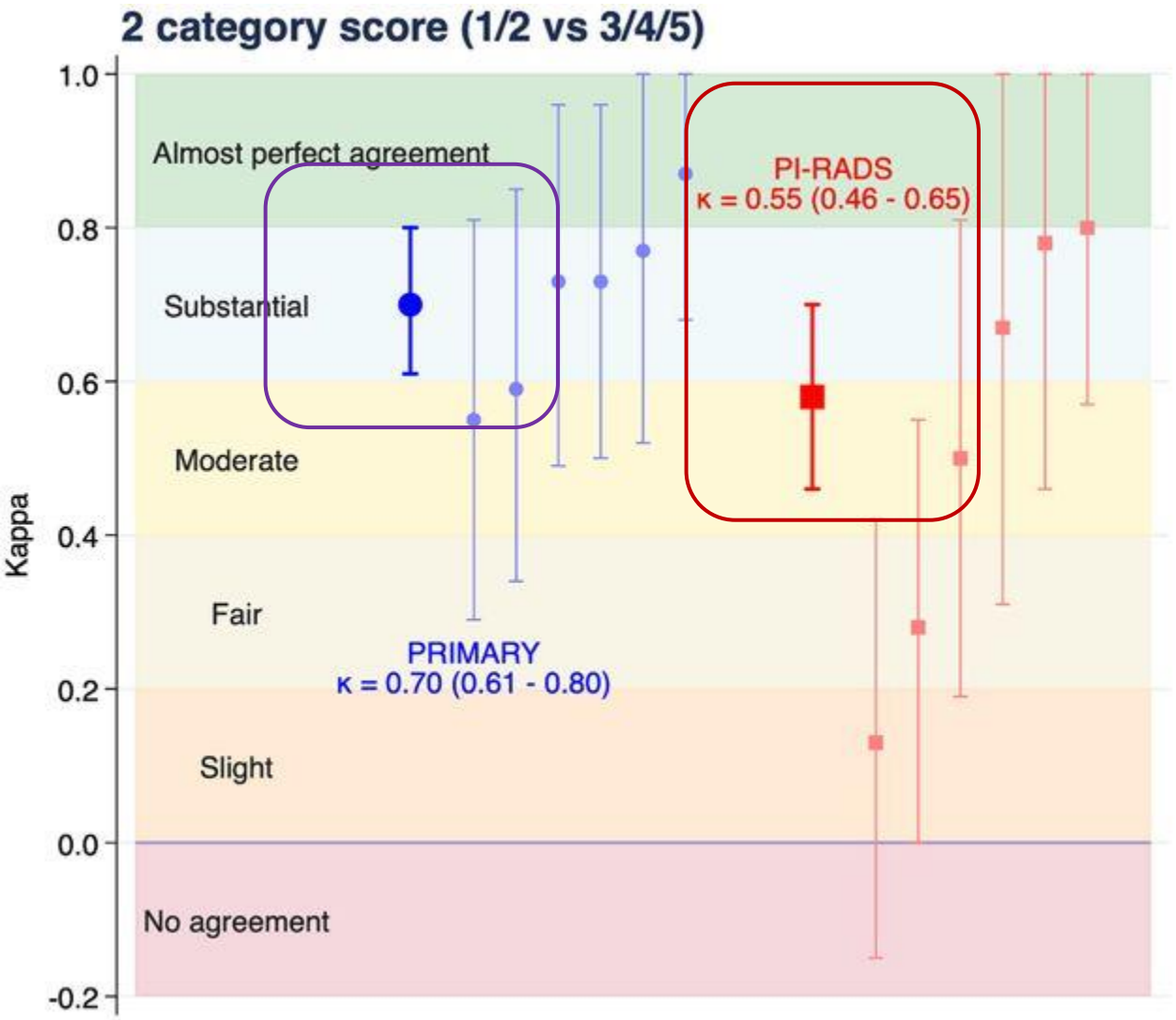


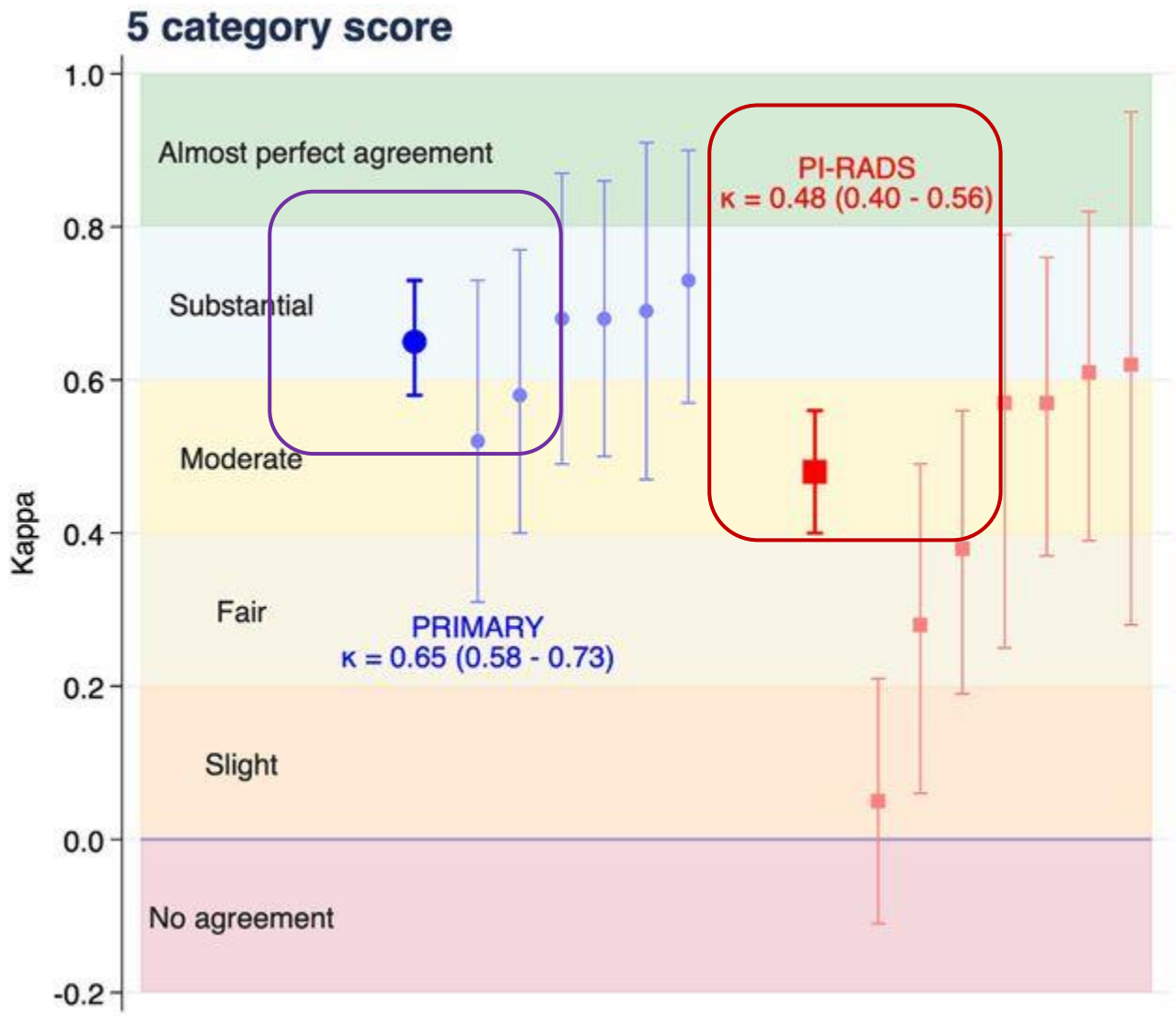
- **Concordant Positive**
- **Concordant Negative**
- **Minor Discordance** (larger/additional)
- **Major Discordance** (different lesions/only-one modality)



Mazzone, Eur Urol 2025; Woo, Eur Radiol 2025

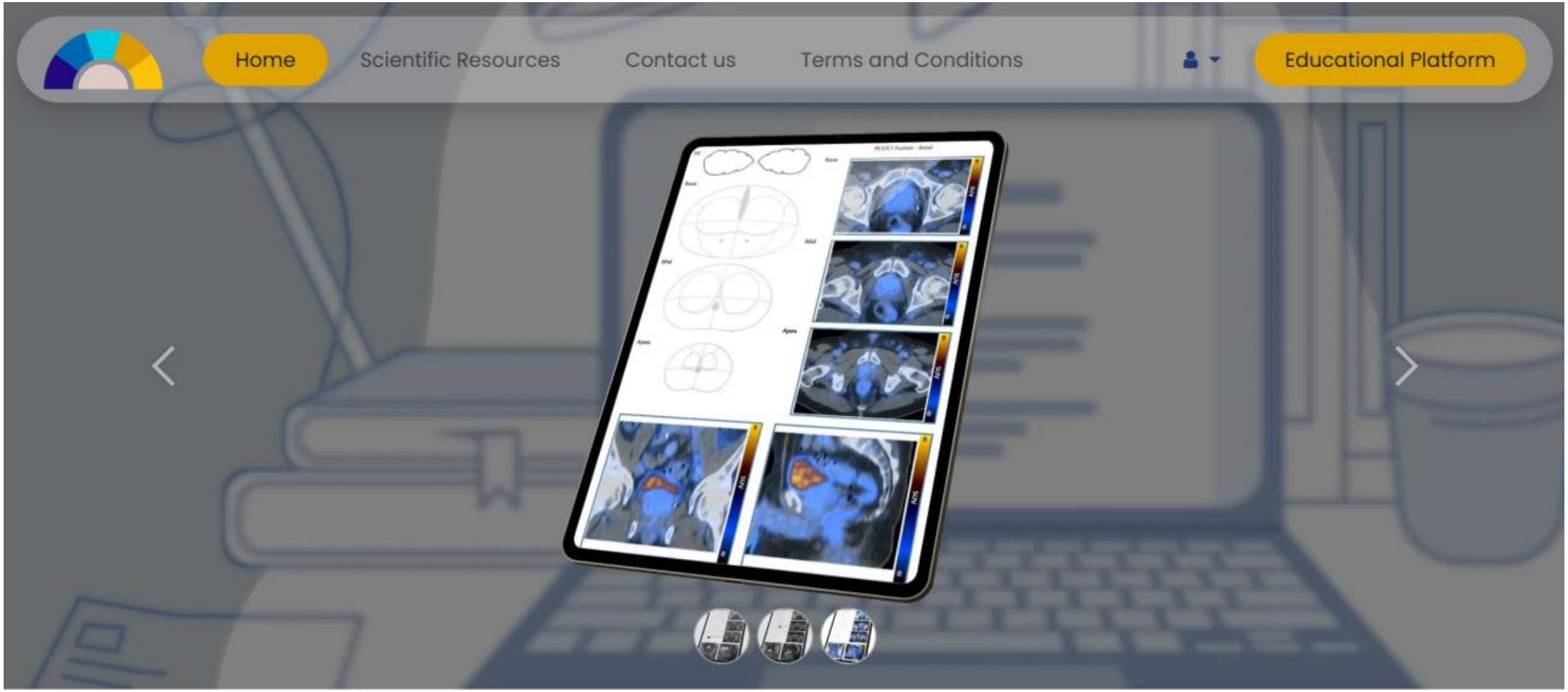
Concordance Between Readers
(mpMRI vs. PSMA PET/CT)





Emmett, JNM 2024

primaryscore.com



Case #1 (Cont.)

ChatGPT

mpMRI: PIRADS 5 (SVI [-])

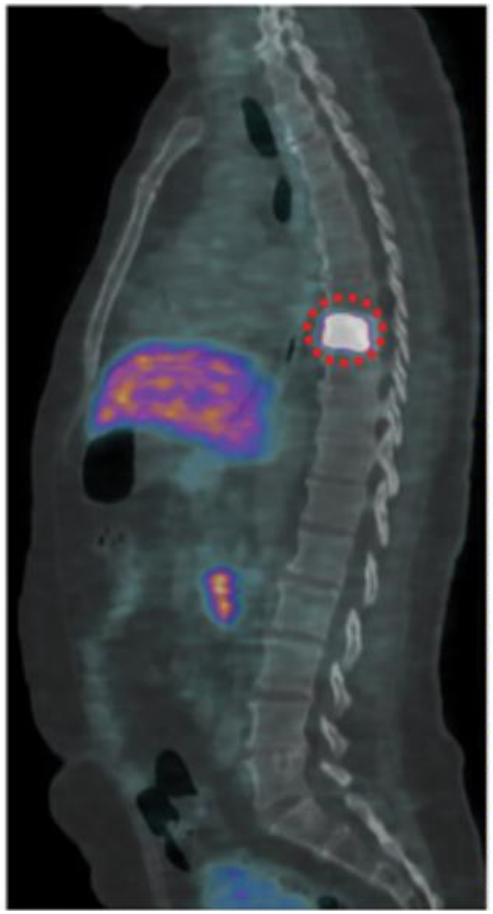
PSMA PET/CT: miT3b N0 M0 (rib: PSMA-RADS IIIB)

a) How to approach equivocal lesions?

b) Metastasis-directed therapy to the rib lesion (dos and don'ts)?

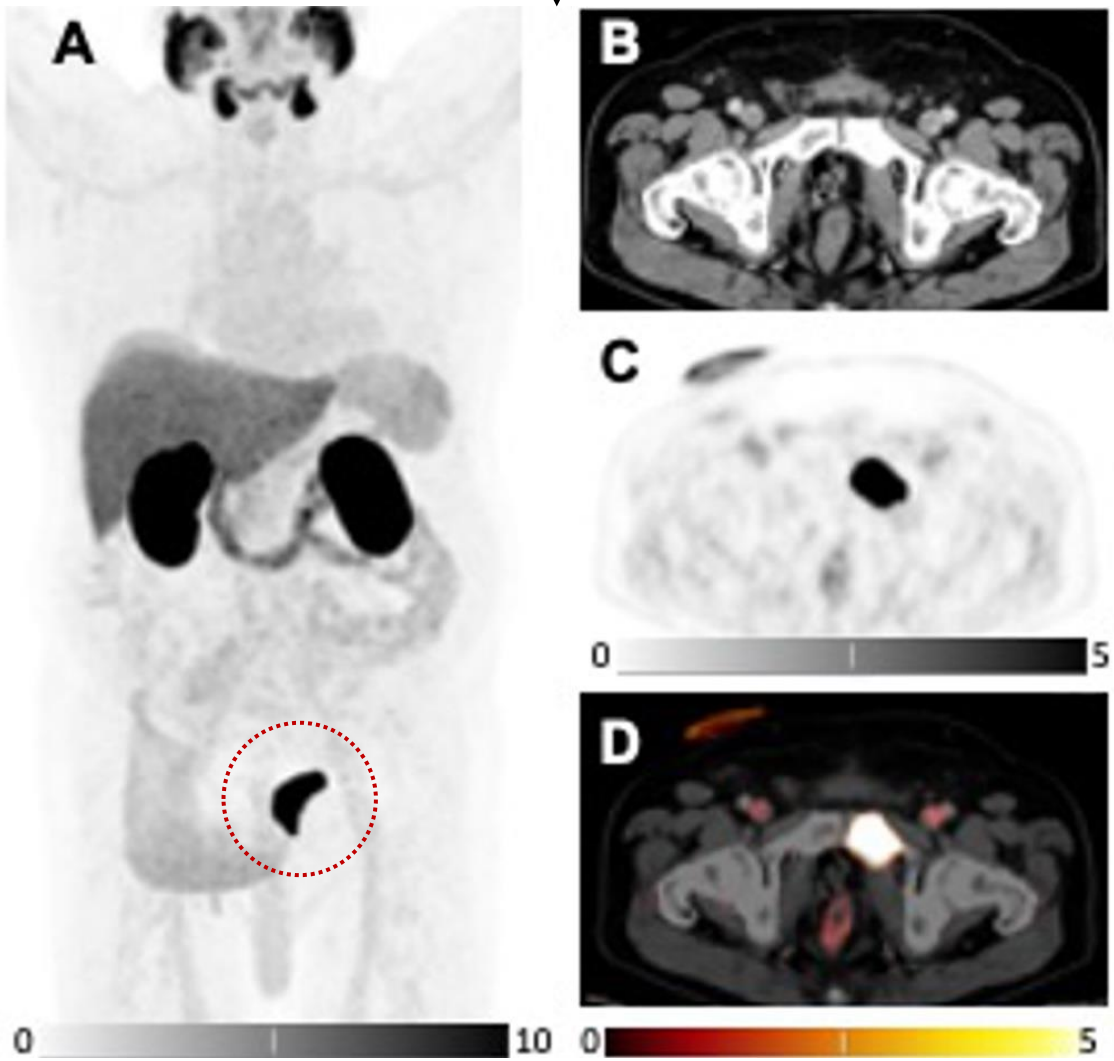
c) NCCN/EAU risk category?

Based on imaging findings indicating extraprostatic extension but no nodal involvement or distant metastases at this stage, the patient would be classified as intermediate- to high-risk localized prostate cancer per NCCN/EUA criteria.



PSA: 4.0 ng/mL

Biochemical recurrence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B
C
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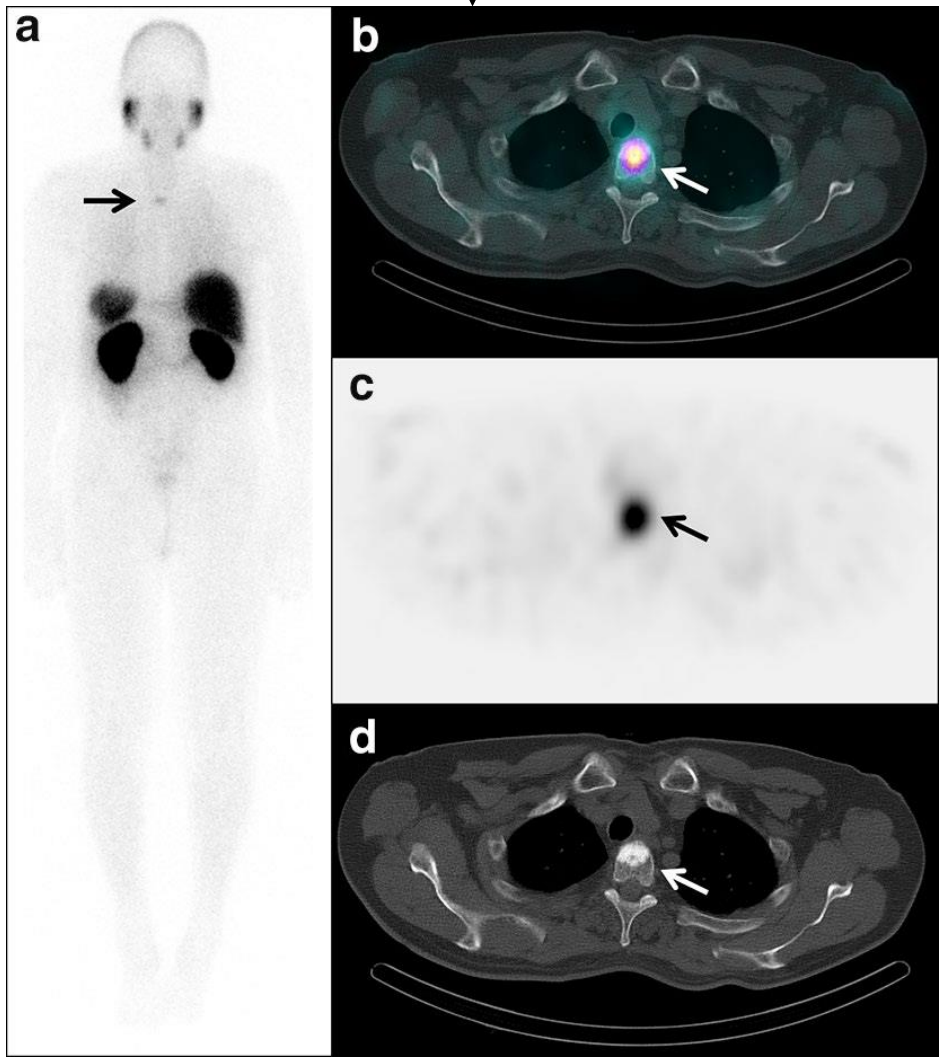
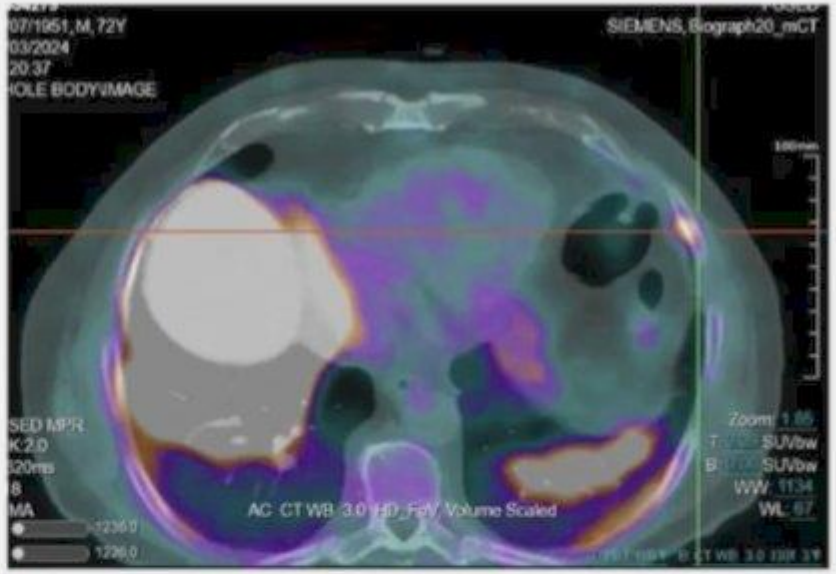
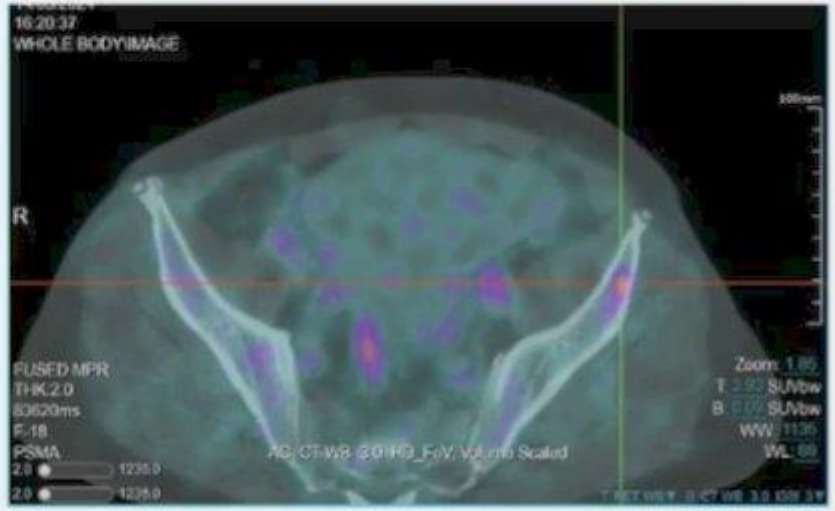

a
b
c
d


F PSMA 1007

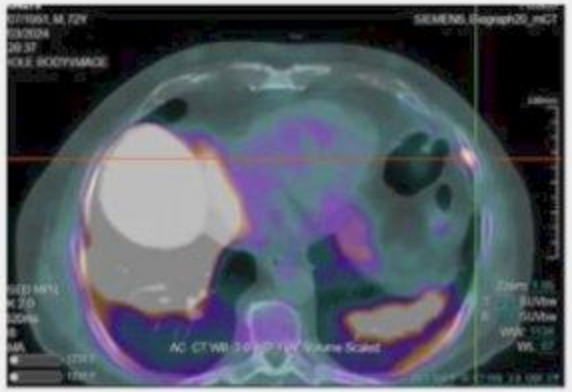

SIEMENS, Biograph20_mCT
WHOLE BODYIMAGE
AC CT WB 3.0 HD_FoV Volume Scaled

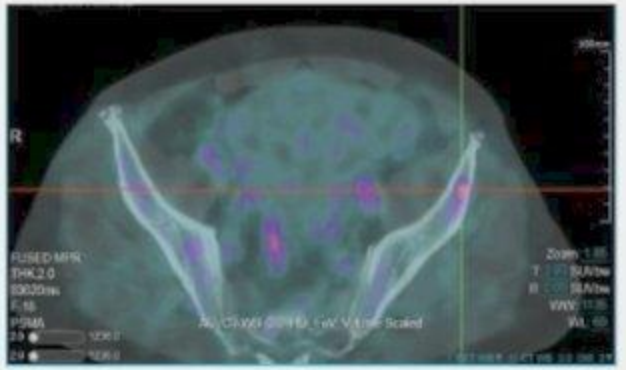

WHOLE BODYIMAGE
R
FUSED MPR
PSMA

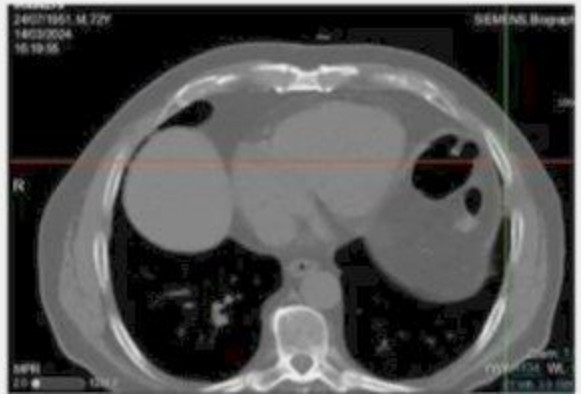
M1?

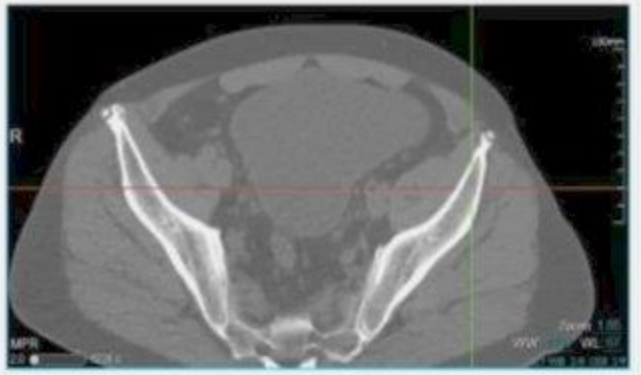
F PSMA 1007

Ga PSMA 11

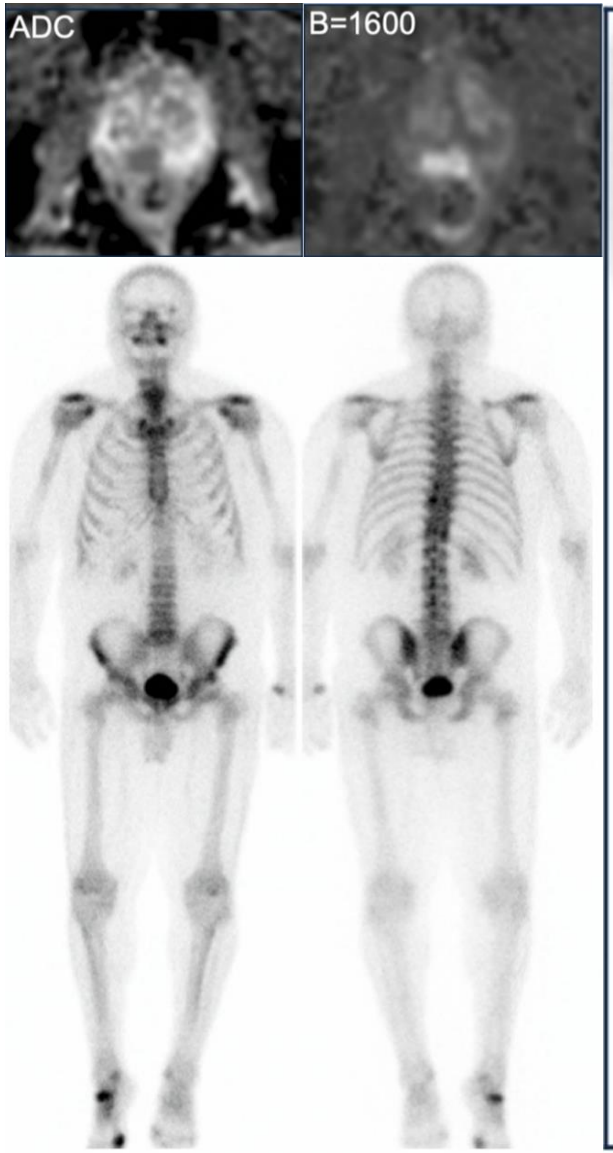




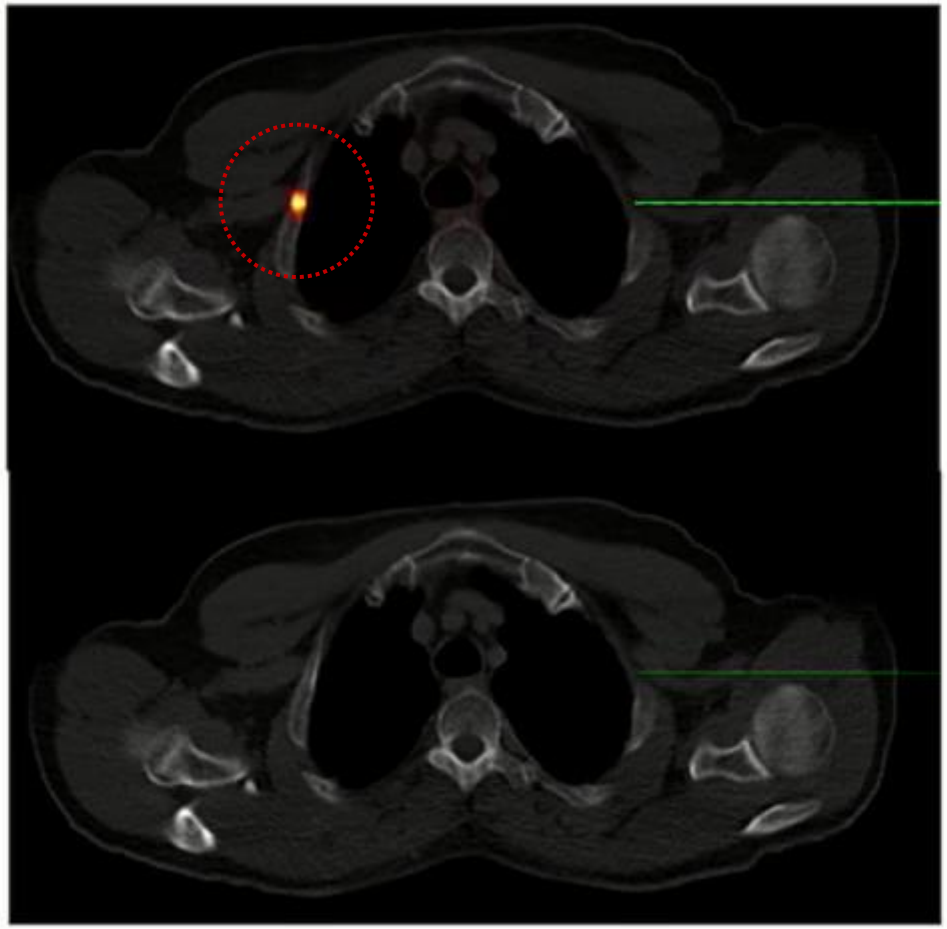




Initial Staging [cT3b, GS 4+4, PSA 9.3]



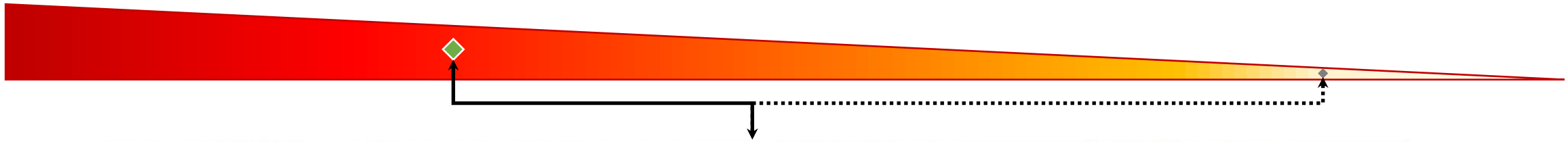
GS 4+5,
BCR PSA 0.55

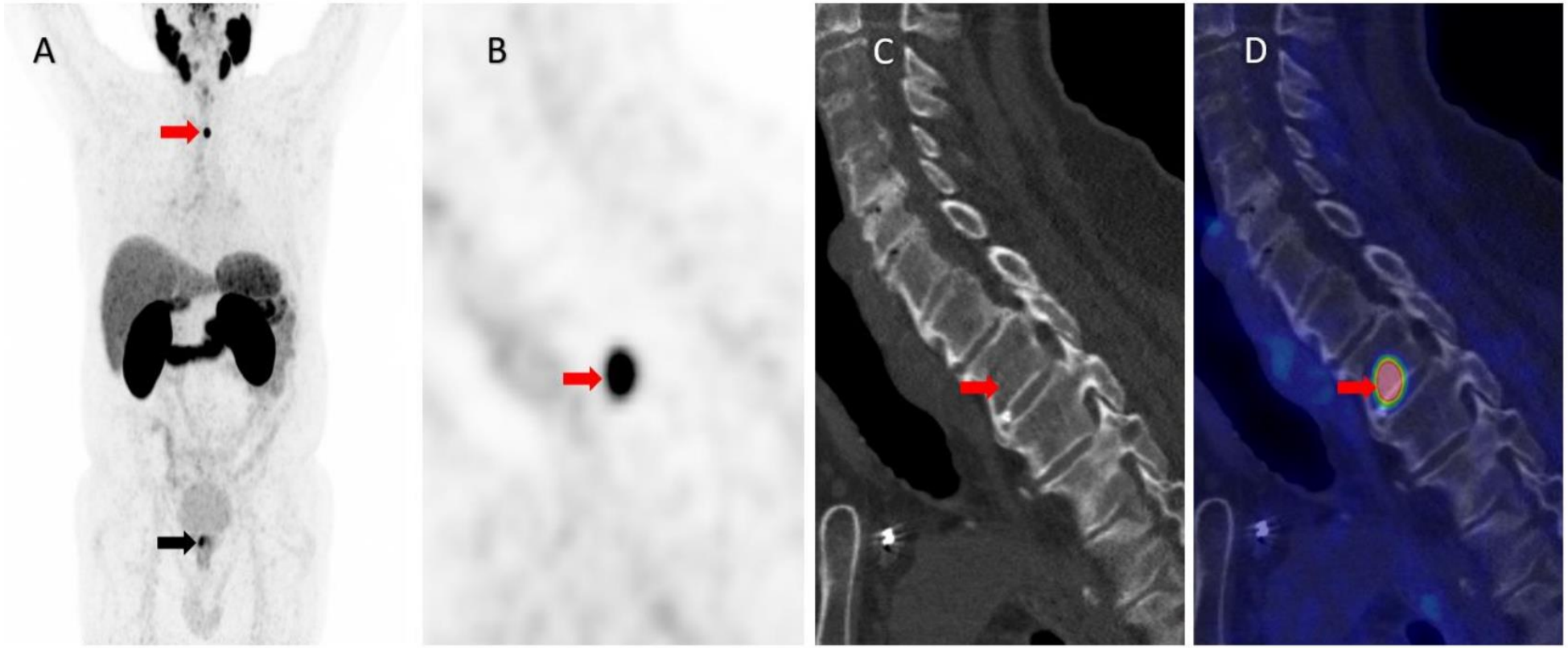


SUVmax 17
CT negative
Isolated

Focal + Intense uptake
=
very high probability of PCa

Lesion treated with SBRT
with good PSA response

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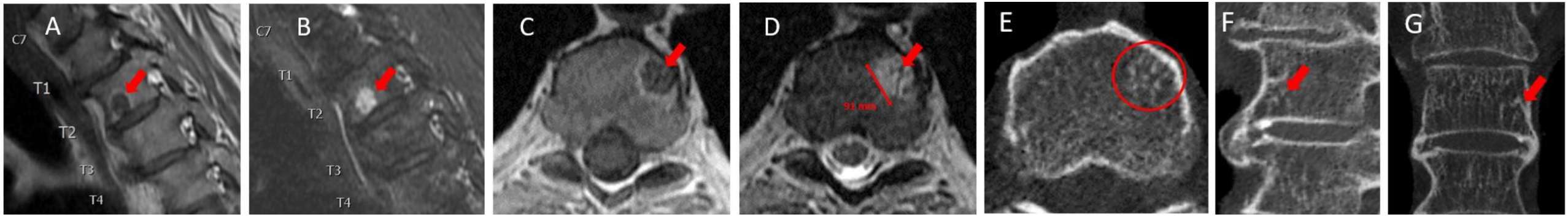
A
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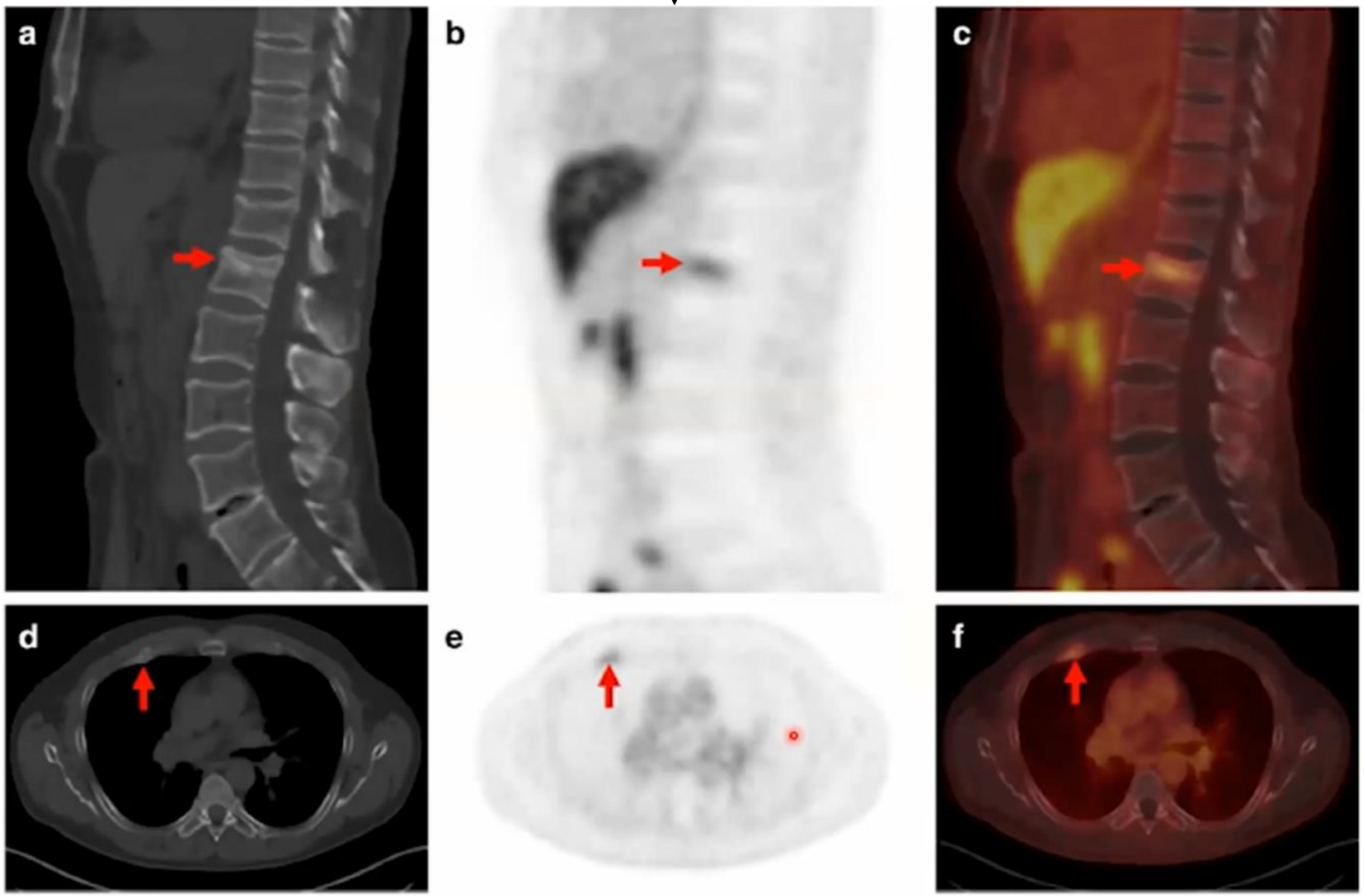
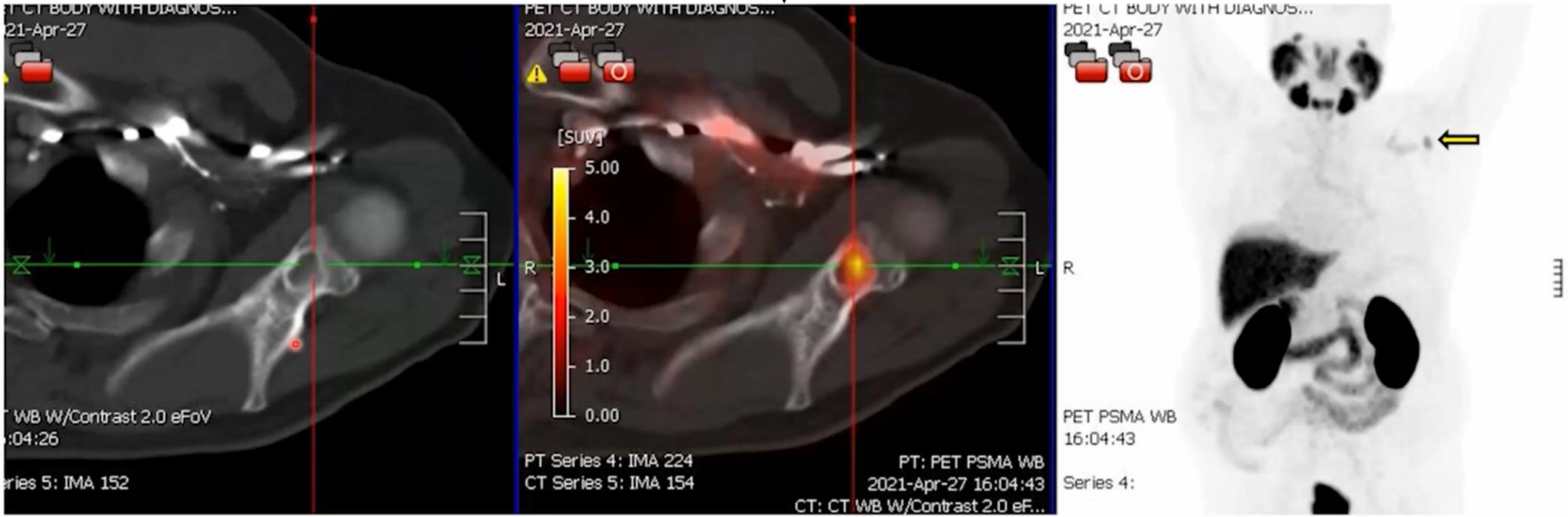
91 mm
E
F
G



Sheikhbahaei et al. EJNM 2017



LUCENT LESION WITH SCLEROTIC RIM
Non aggressive
Not Prostate Cancer

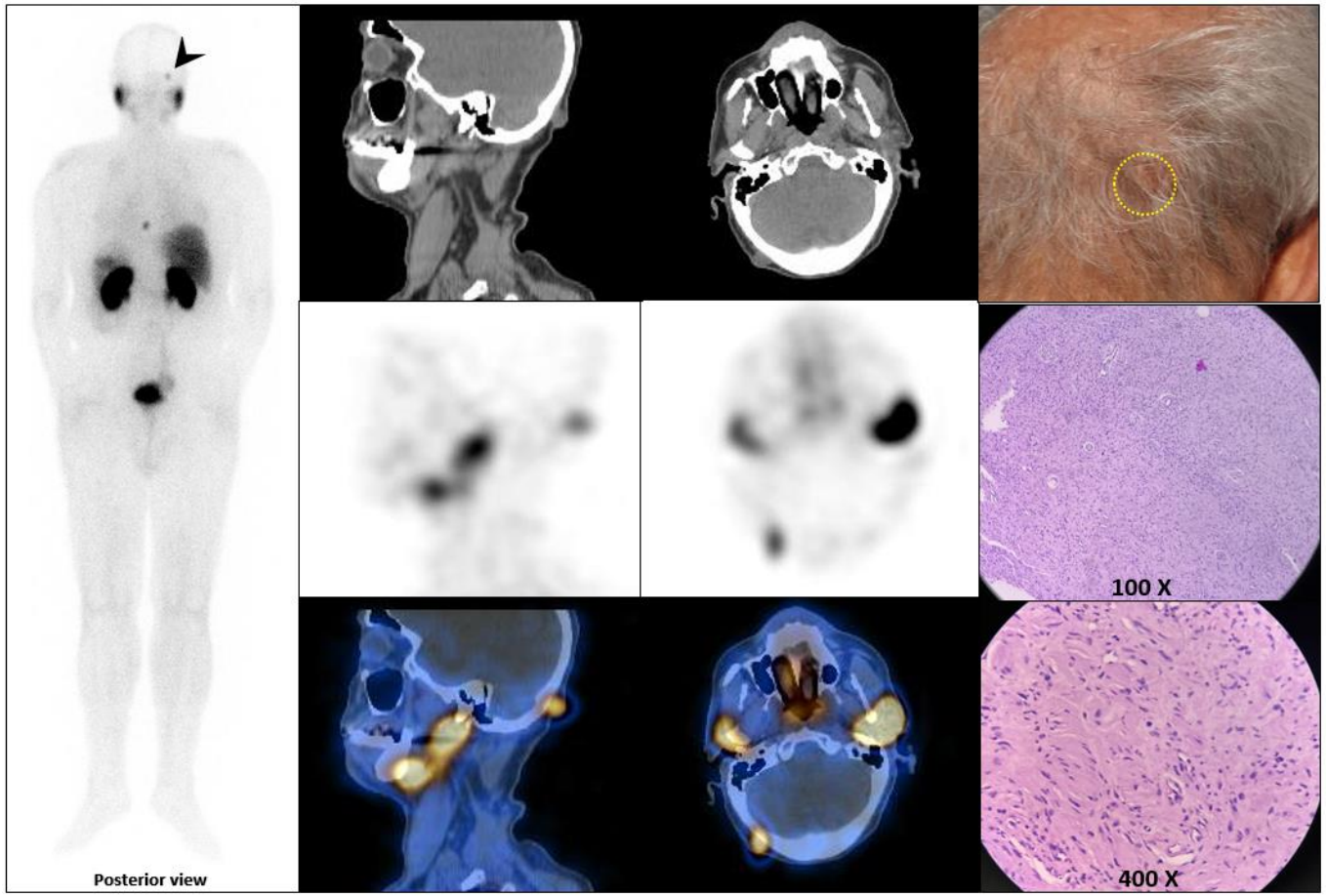
degenerative cyst.

more often in the hip rather than in the shoulder.

All that glitters is not gold!

False positive lesions with high SUVs:

- **Vascular lesions:**
  - ✓ *Hemangioma*
  - ✓ *Hemangiopericytoma*
  - ✓ *Angiolipoma*
- *Paget's disease*
- *Desmoid tumor*
- *Neurofibroma*
- *Hibernoma*
- *Chronic beryllium lung disease*
- *A few second primary malignancies*



Neurofibroma [Samadi, CNM 2025]

Swiha, Semin Nucl Med 2023

TIPS for PSMA PET/CT Reporting

Faint
Diffuse (not focal)
Isolated
Symmetric (also Coronal view)
Uncommon Location for Prostate Cancer Spread
Decreased Uptake on late Acquisition
CT Correlate Pattern

Probably NOT Prostate Cancer

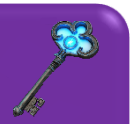
Intense
Focal
Known other metastatic lesions
Asymmetric (also Coronal view)
Common Location for Prostate Cancer Spread
Increased/stable uptake on late acquisition
Lesion size (PSMA-TV)

Suspicious for Prostate Cancer

PET Physician Perspective:
I must **not miss a lesion**
I need to back-up myself **in case of pursuit**

= Sensitivity

MDT Discussion



Clinician Perspective:
How do I treat this image finding?
Is it real?

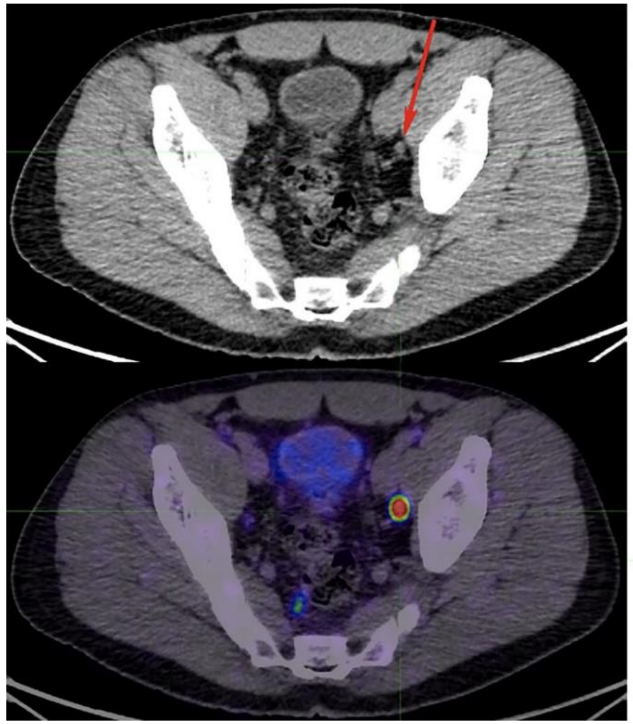
= Specificity

A Slow Paradigm Shift!

Definitive therapy should not be denied for those with negative conventional imaging but positive PSMA PET [ESMO 2020].

- ✓ In patients with **BCR** who have **non-regional disease** seen **on PET/CT but no visible disease on conventional imaging**, clinicians **may omit salvage RT to the prostate bed** and should **discuss** the **uncertain role of systemic therapy** in this setting.

[AUA/ASTRO/SUO 2024]



- ✓ If **mi-only omPC** is **not covered by MDT**, it has a **detrimental effect on OS**

[APCCC 2024 consensus: **if MDT is planned, use NGI**]

Morgan, J Urol 2024 Gillessen, Eur Urol 2024 Parker, Ann Oncol 2020

PSMA PET M1b (+) & underlying CT (+): **no additional work up**

PSMA PET M1b (+) & underlying CT (-) **additional work up**

APCCC 2022
&
APCCC 2024
Consensus Guidelines

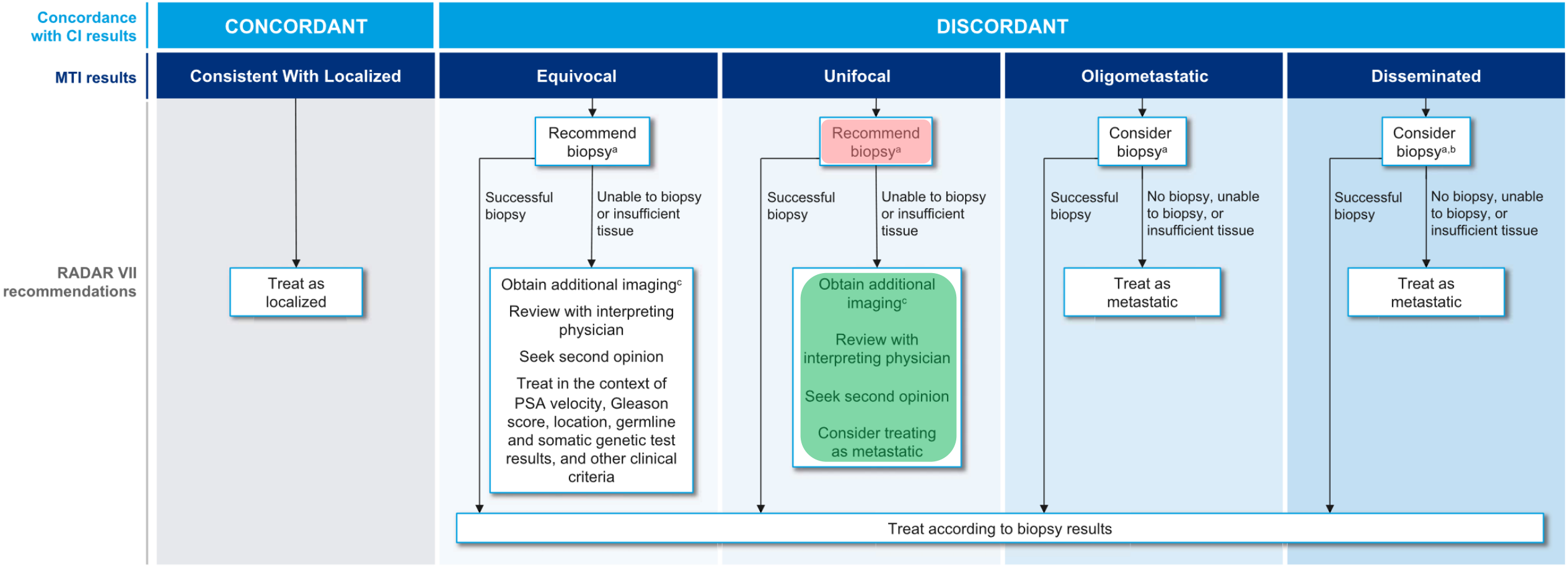
Q6. For patients with clinically localised prostate cancer with PSMA-positive findings consistent with metastases in the bone on the CT component of upfront PSMA PET, 78% of panellists voted not to recommend additional imaging (eg, MRI or bone scintigraphy) and 22% voted to recommend it. (Consensus not to recommend additional imaging.)

Q7. For patients with clinically localised prostate cancer and PSMA PET–positive lesions in the bone without a correlate on the CT component of upfront PSMA PET, 73% of panellists voted to recommend additional imaging (eg, MRI or bone scintigraphy) and 27% voted not to recommend it. (No consensus for any given answer option.)

Same results in 2024

How to deal with negative conventional imaging cases while PSMA scan is positive? (Staging)

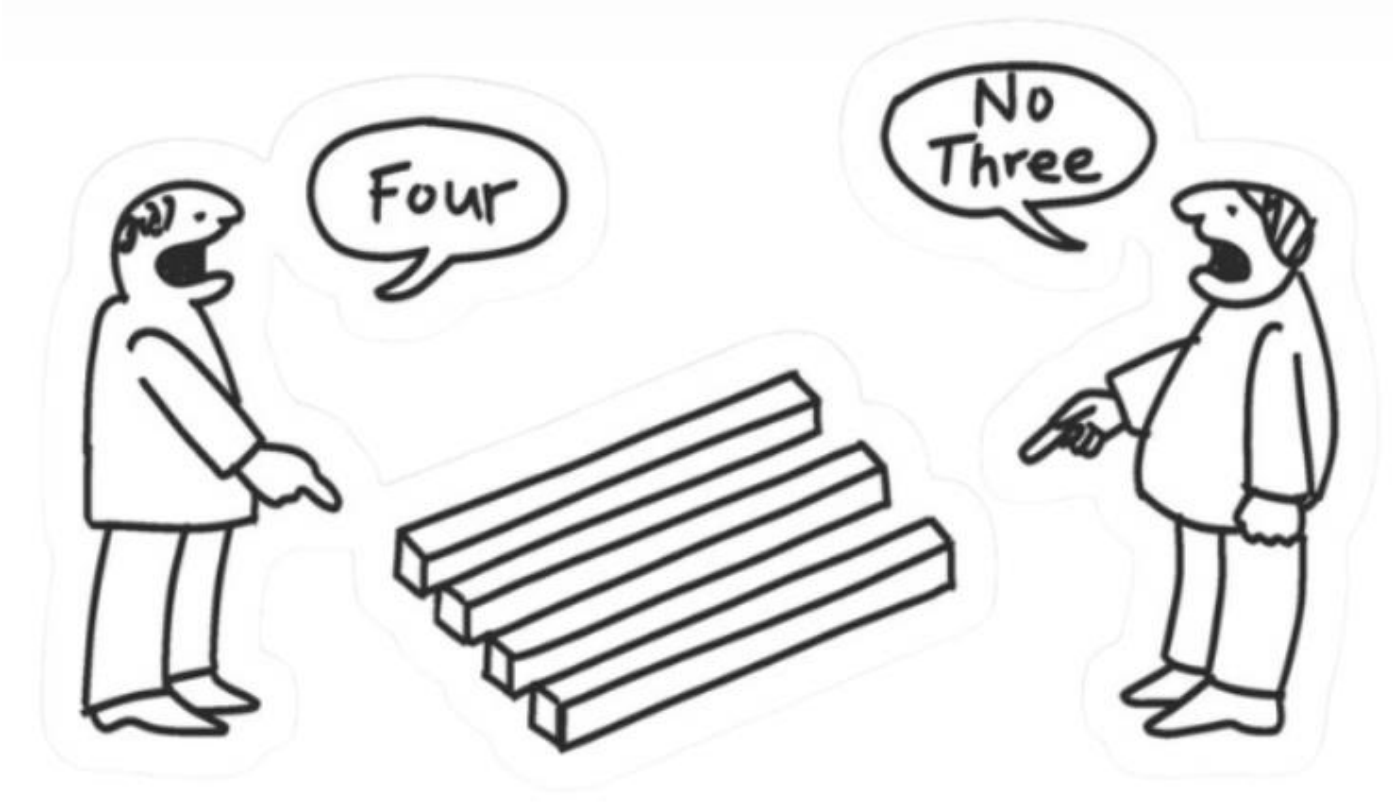
The **RADAR VII guideline** recommends:



[a] Biopsy options include interventional radiology or lymph node dissection. [b] Consider for disease with high-risk features such as neuroendocrine differentiation, high-volume metastatic disease, and rapid PSA velocity, among others. [C] Consider magnetic resonance imaging and/or computed tomography.

Crawford, JU Open Plus 2023

How to validate M1? Consensus Reading



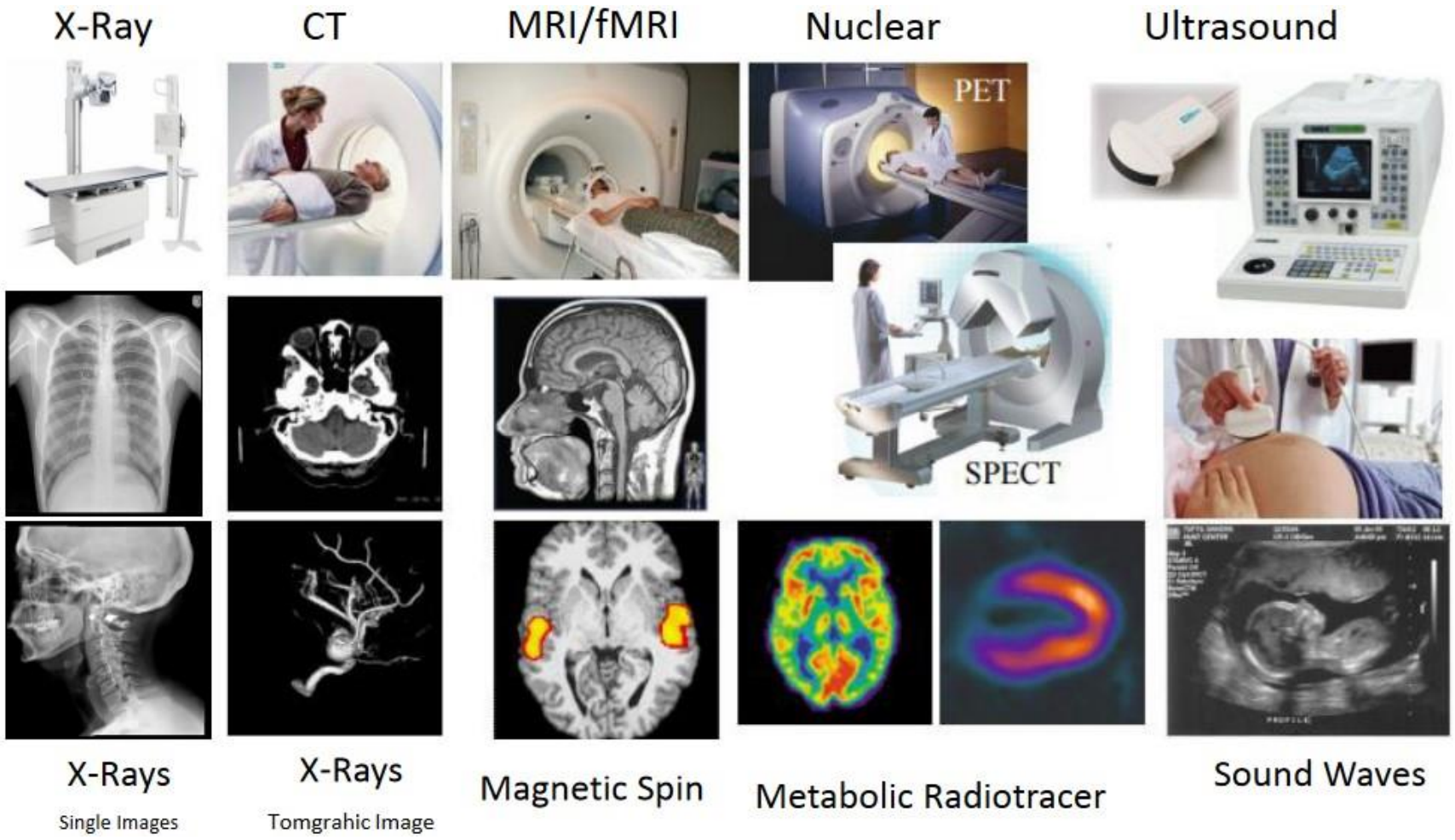
✓ **Isolated bone mets. outside pelvis/vertebra = rare** (1%)

✓ Highest (~70%) inter-reader agreement = PSMA PET/CT

Chavoshi, EJNMMI 2022

Rizzo, EJNMMI 2024

How to validate M1? Correlative Imaging



✓ Risk of malignancy for equivocal bone lesions (**PSMA-RADS 3B**) in ^{68}Ga-PSMA-11 PET/CT = ~30% (29-32.6%)

Mainta, JNM 2024

Woo, CATI 2024

How to validate M1? Waiting vs. Action

25% of bone Bx are **non-diagnostic!**

ProPSMA accuracy validation protocol

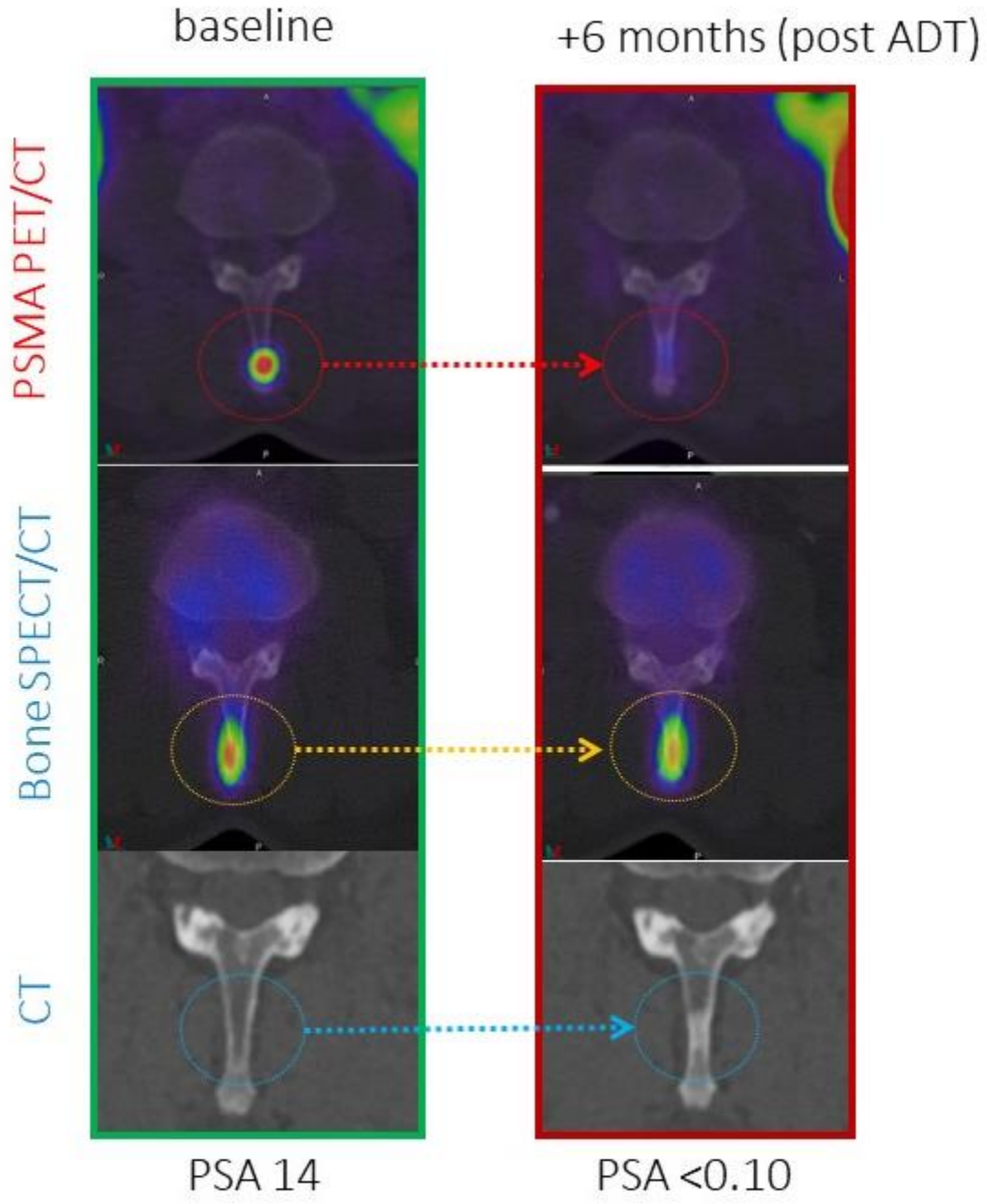
Hard criteria (≥1)

- Histopathology
- Δ to sclerotic (bone)

OR

Soft criteria (≥3)

- Multi-focal metastases
- Typical appearance on 2nd imaging modality
- ↑size/no lesions
- ↓size/no following Rx
- ↑ or ↓ PSA
- Localised treatment
- Persistence of baseline finding & PSA >0.2 following prostatectomy



Gleason 4+5=9 prostate carcinoma

Hofman, Lancet 2020

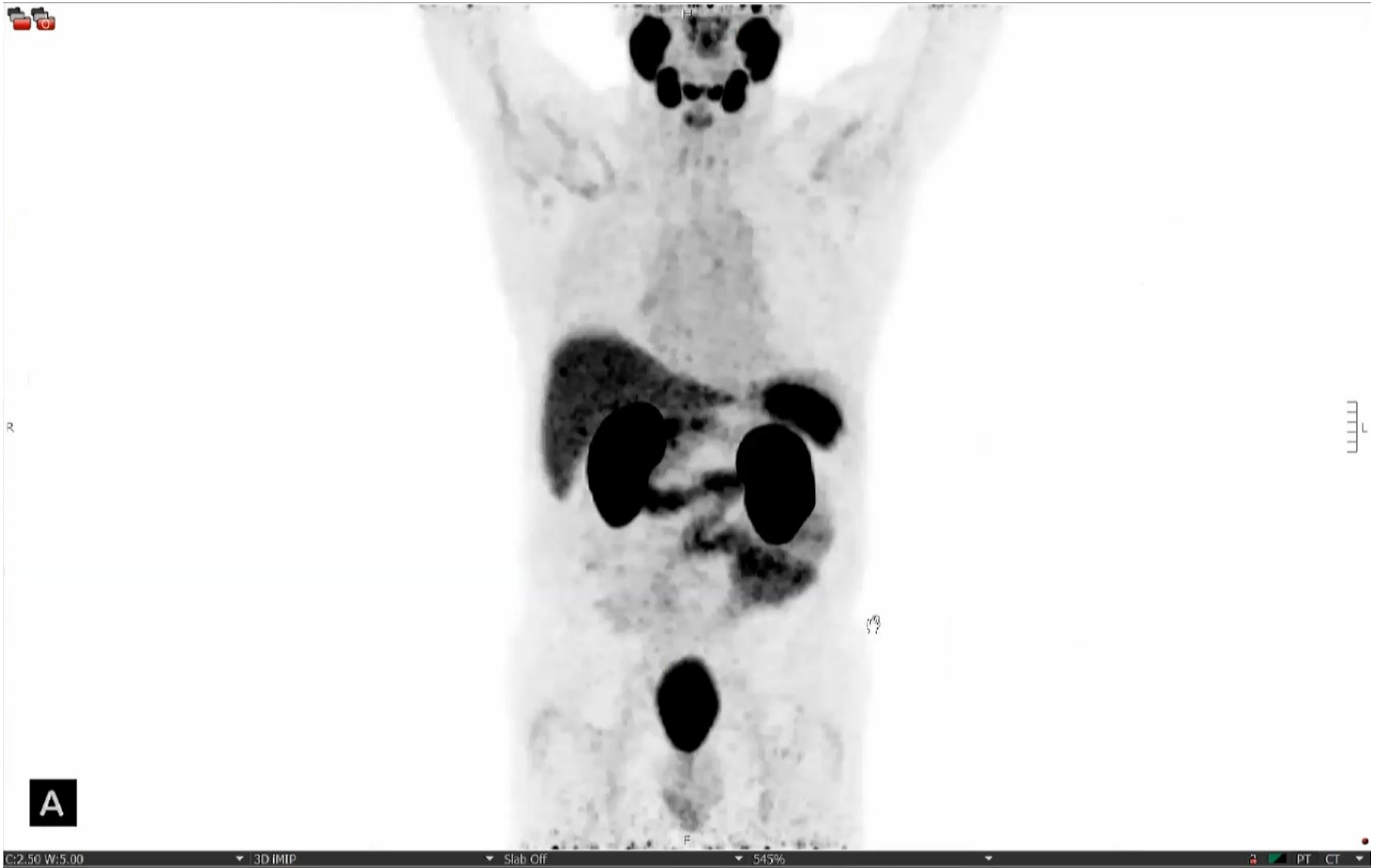
PSMA vs. Histopathology (mostly meta-analyses)

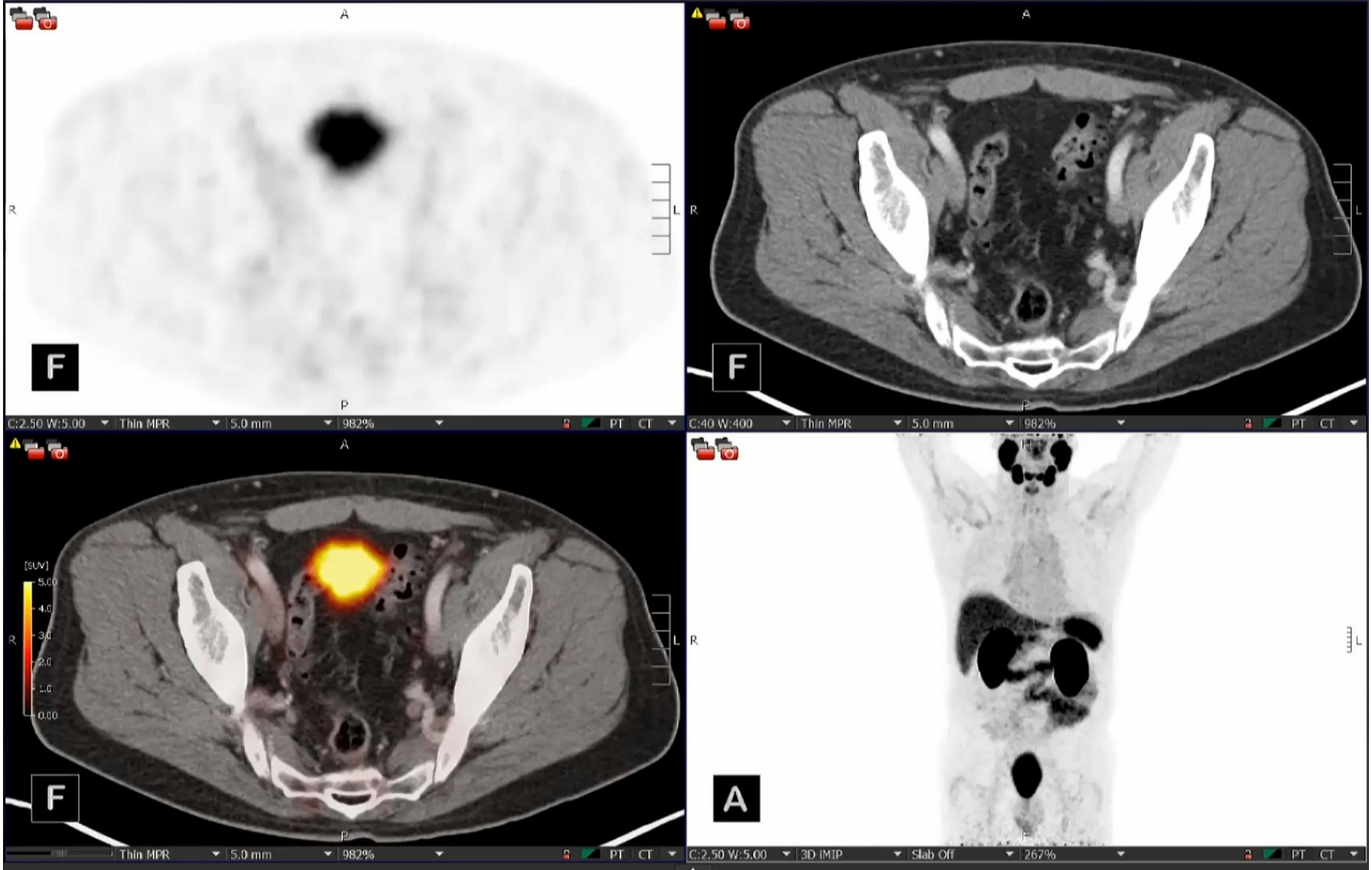
- ✓**T-category:** sensitivity = 71%, specificity = 92%
  - **Intraprostatic (csPCa):** accuracy = 86% (PET/CT), 97% (PET/MR)
    - **PRIMARY-PIRADS composite score:** improved **NPV** & **sensitivity** compared to mpMRI
  - **EPE:** accuracy = 73% (PET/CT), 77% (PET/MR)
  - **SVI:** accuracy = 87% (PET/CT), 90% (PET/MR)
  - **miTr (BCR):** sensitivity = 84%, specificity = 97%
- ✓**N-category: sensitivity = 57%**, specificity = 96%
  - Weakness: **small LNs (<5 mm**; **gold standard** is still **ePLND)**
- ✓**M-category:**
  - **M1b:** sensitivity = 97%, specificity = 100% (Weakness: BVC, **UBU**)
  - **M1c:** lung (27.5% **PSMA-negative**), liver (22.3% **PSMA-negative**) (Weakness: **NED**)
  - **OSPREY trial (Histopathlogy; PPV): M1b = ~81%, M1c = ~93%**

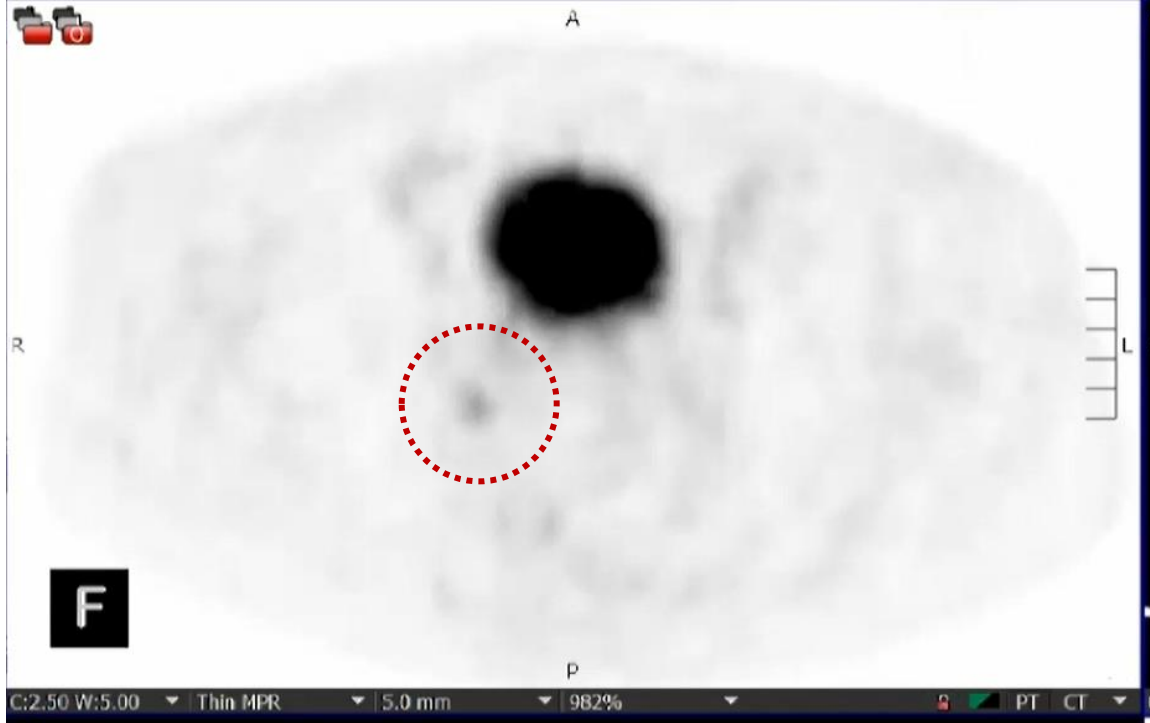
Hope, JNM 2019; Satapathy, AJR 2021; Pienta, J Urol 2021; Emmett, Eur Urol 2021; Zhou, Hell J Nucl Med 2022; Jeet, Semin Nucl Med 2023; Gossili, EJNMMI 2023

Case #2

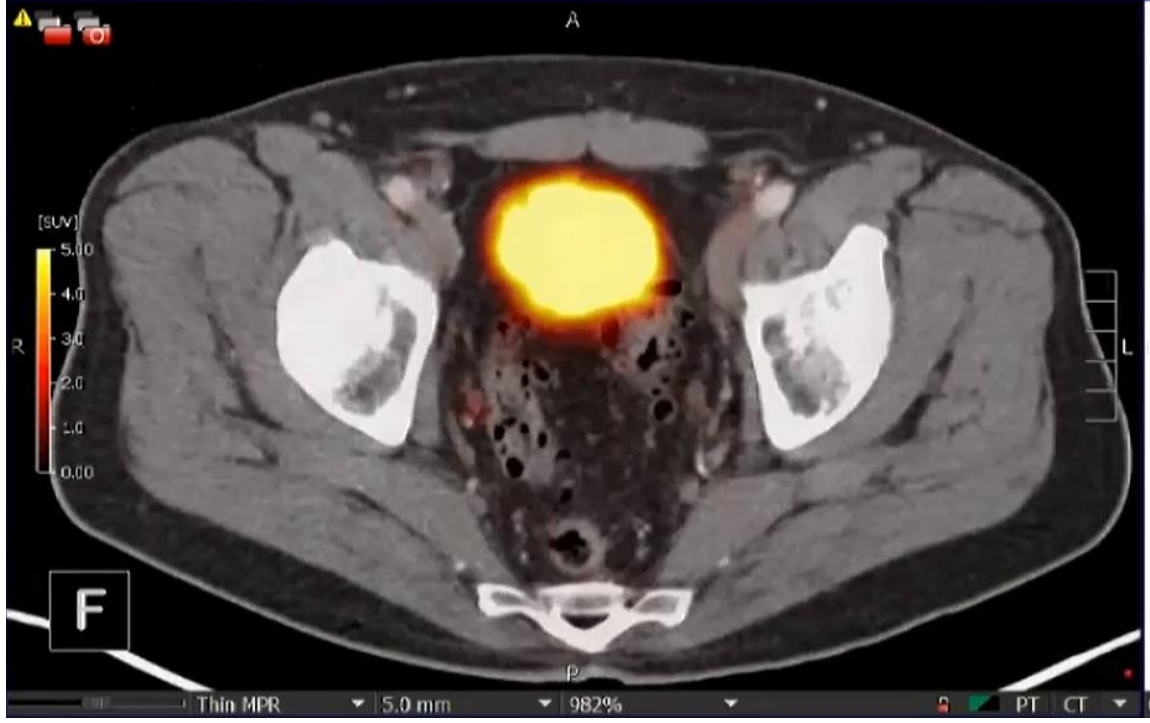
- 68-year-old gentleman
- s/p RP 1/11/2016
- pT2cN0, pGS 4+3, margin negative (0/4) nodes
- His first post-op PSA 0.03 but rose to 0.12 on 8/6/2016.
- It has since increased to 0.22 on 1/1/2017 with a **PSAdT on the order of 2 months**


A
C:2.50 W:5.00
3D IMIP
Slab Off
545%
PT CT

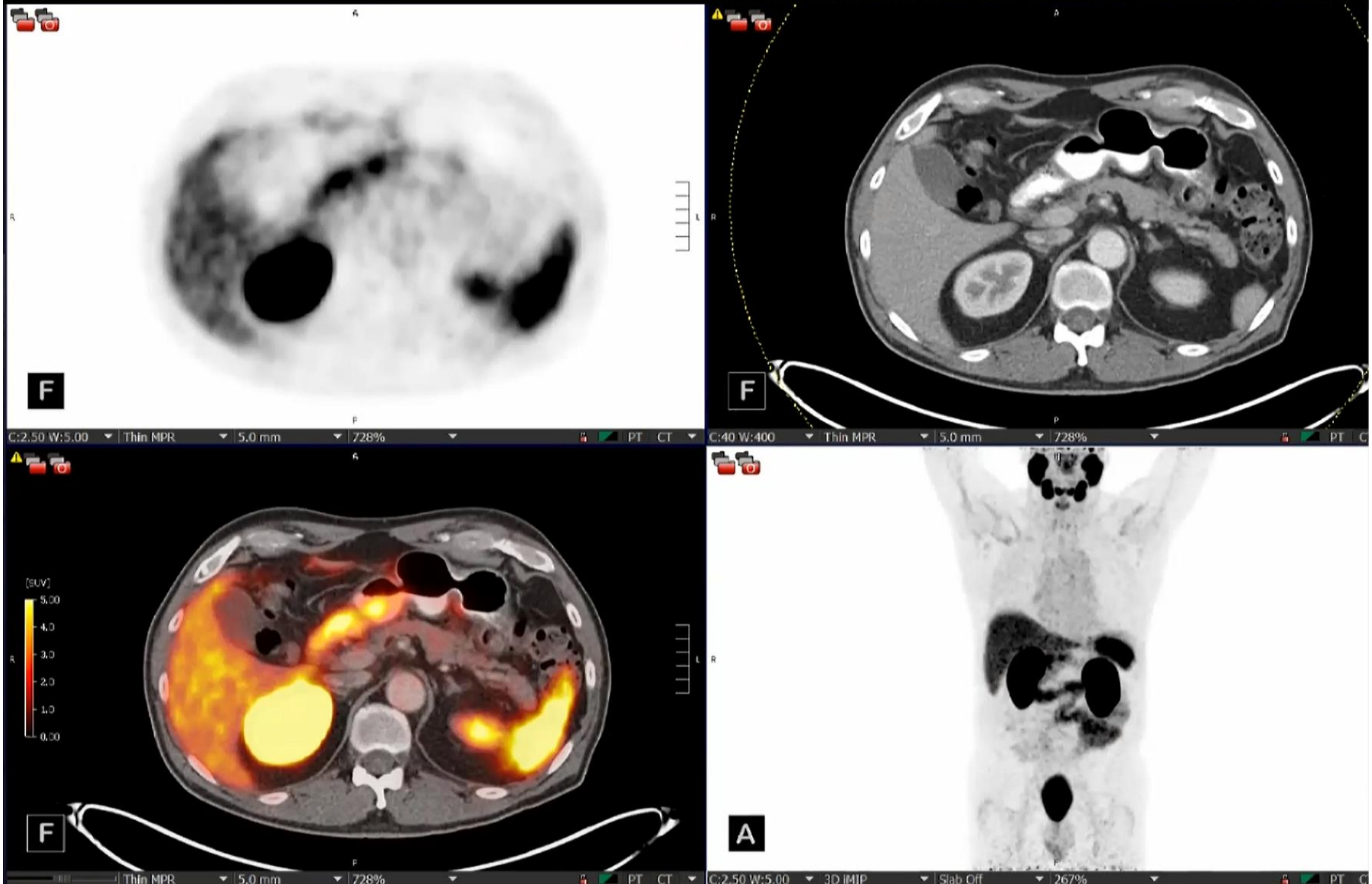

A
R
L
P
F
C:2.50 W:5.00
Thin MPR
5.0 mm
982%
PT
CT
C:40 W:400
[SUV]
5.00
4.0
3.0
2.0
1.0
0.00
3D iMIP
Slab Off
267%


A
R
L
P
F
C:2.50 W:5.00
Thin MPR
5.0 mm
982%
PT
CT


A
R
L
P
F
C:40 W:400
Thin MPR
5.0 mm
982%
PT
CT


A
[SUV]
5.00
4.0
3.0
2.0
1.0
0.00
R
L
P
F
Thin MPR
5.0 mm
982%
PT
CT

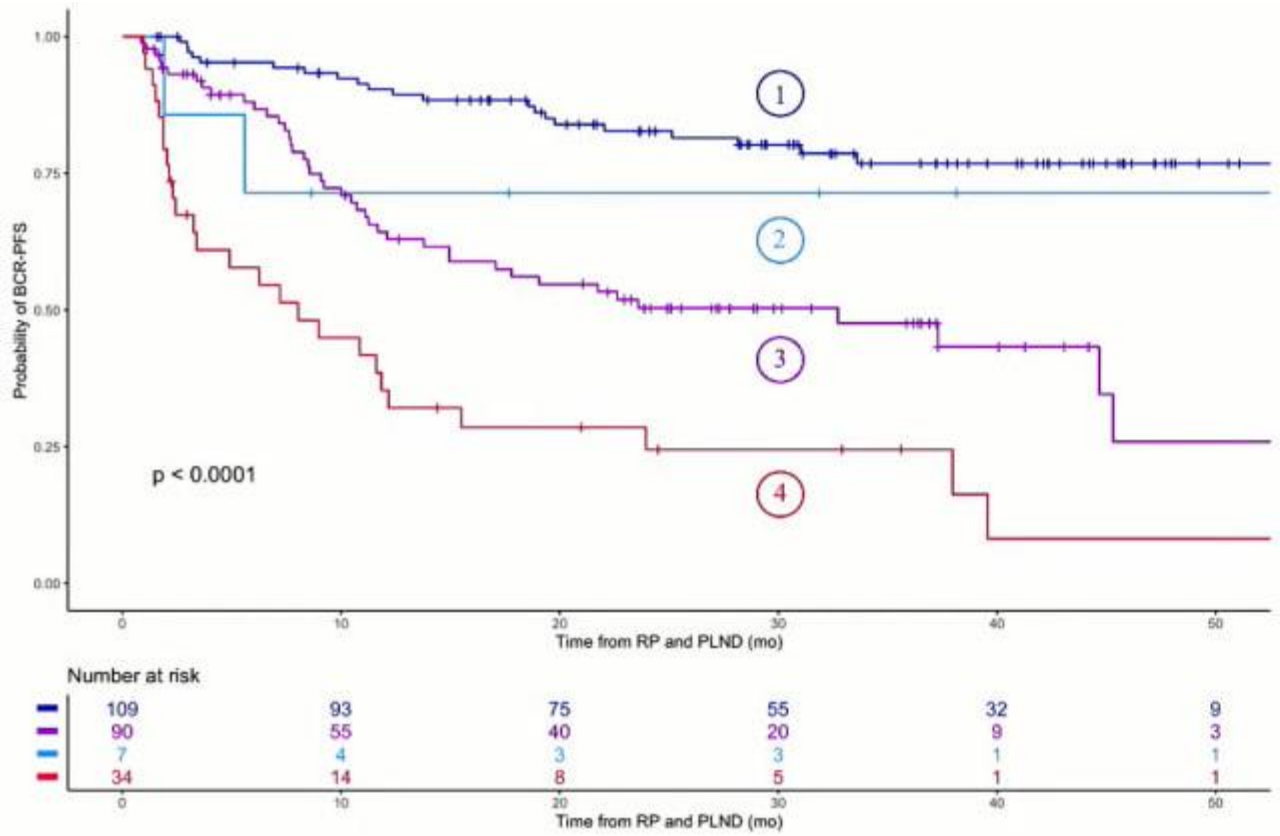

H
R
L
F
A
C:2.50 W:5.00
3D MIP
Slab Off
243%
PT
CT

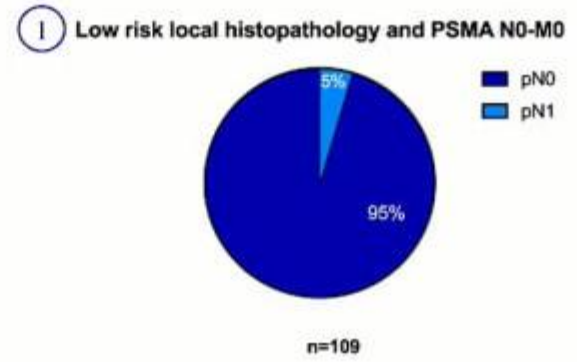

F
C:2.50 W:5.00
Thin MPR
5.0 mm
728%
PT CT
F
C:40 W:400
Thin MPR
5.0 mm
728%
PT
[SUV]
5.00
4.0
3.0
2.0
1.0
0.00
F
Thin MPR
5.0 mm
728%
PT CT
A
C:2.50 W:5.00
3D MIP
Slab Off
267%
PT

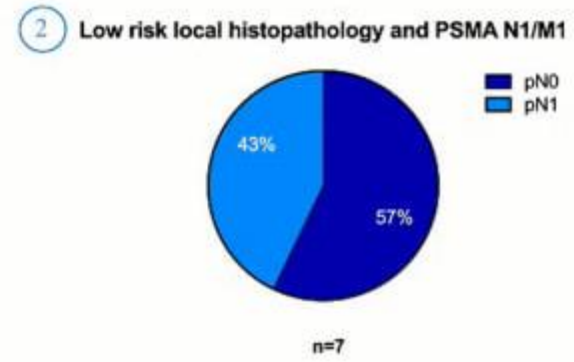
Case #2

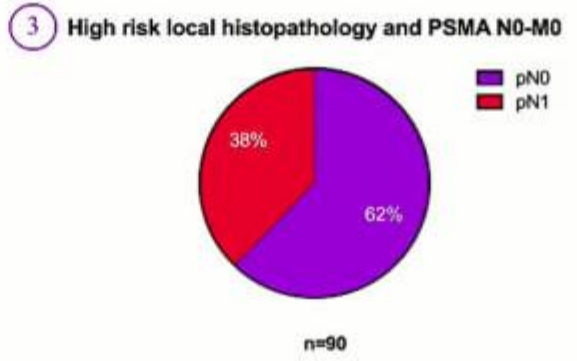
- **PSMA PET** on 1/18/2017 was **negative**.
- **Plan**: **IMRT to the pelvic nodes (50.4 Gy) + prostate bed (72 Gy), completed 6/8/2017 with ADT 6 months**
- **PSA remained undetectable for >4 years** after treatment completion.

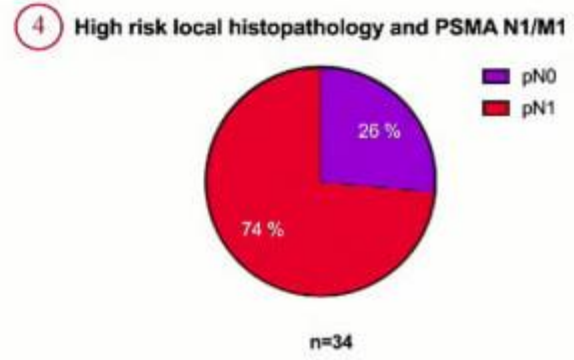
Outcome of Pathology-PSMA PET Discordance







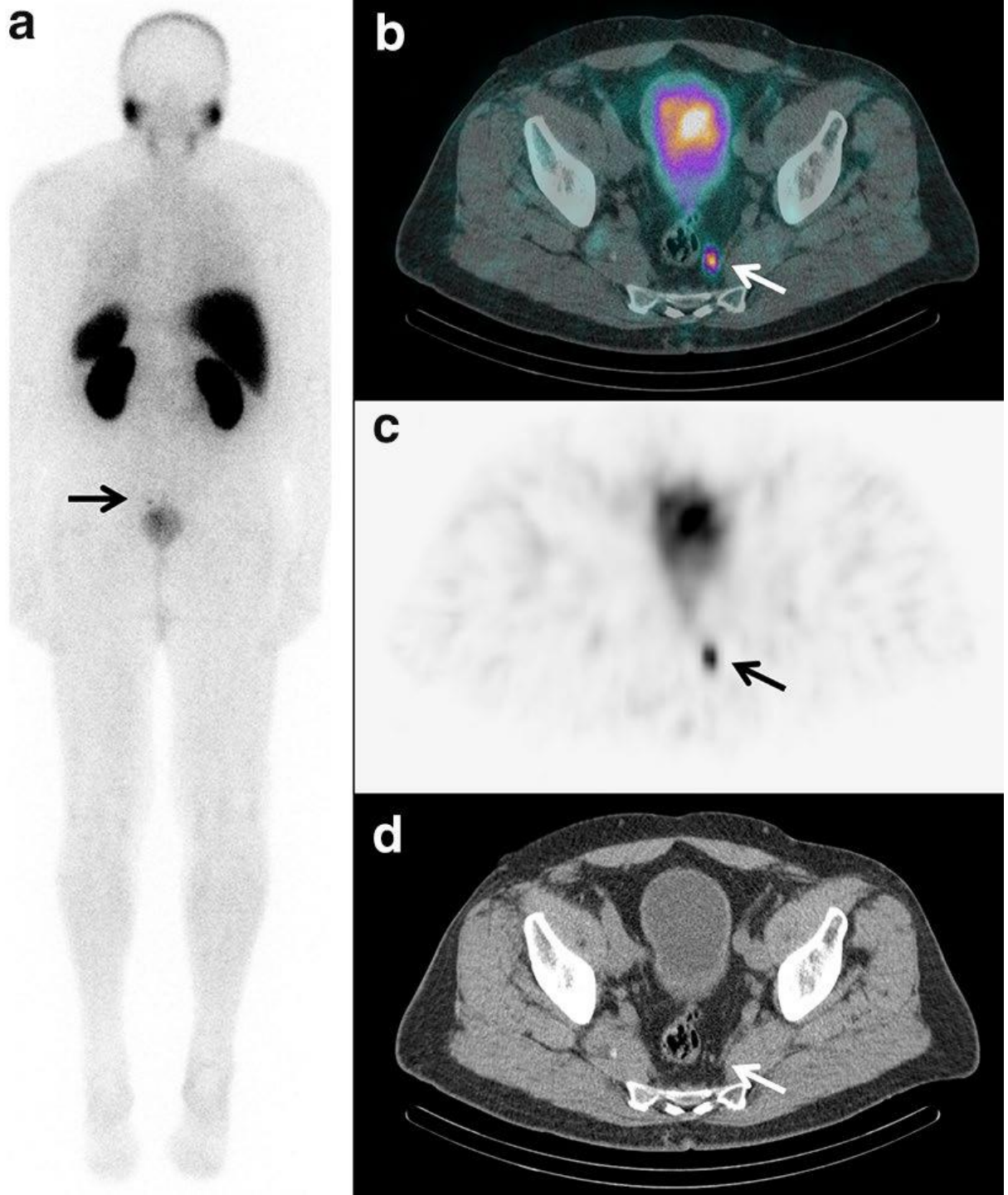




Another case

76 year old patient
GS 4+3
(4/12 cores; no pathology adverse features)
PSA = 7.6
Referred for staging

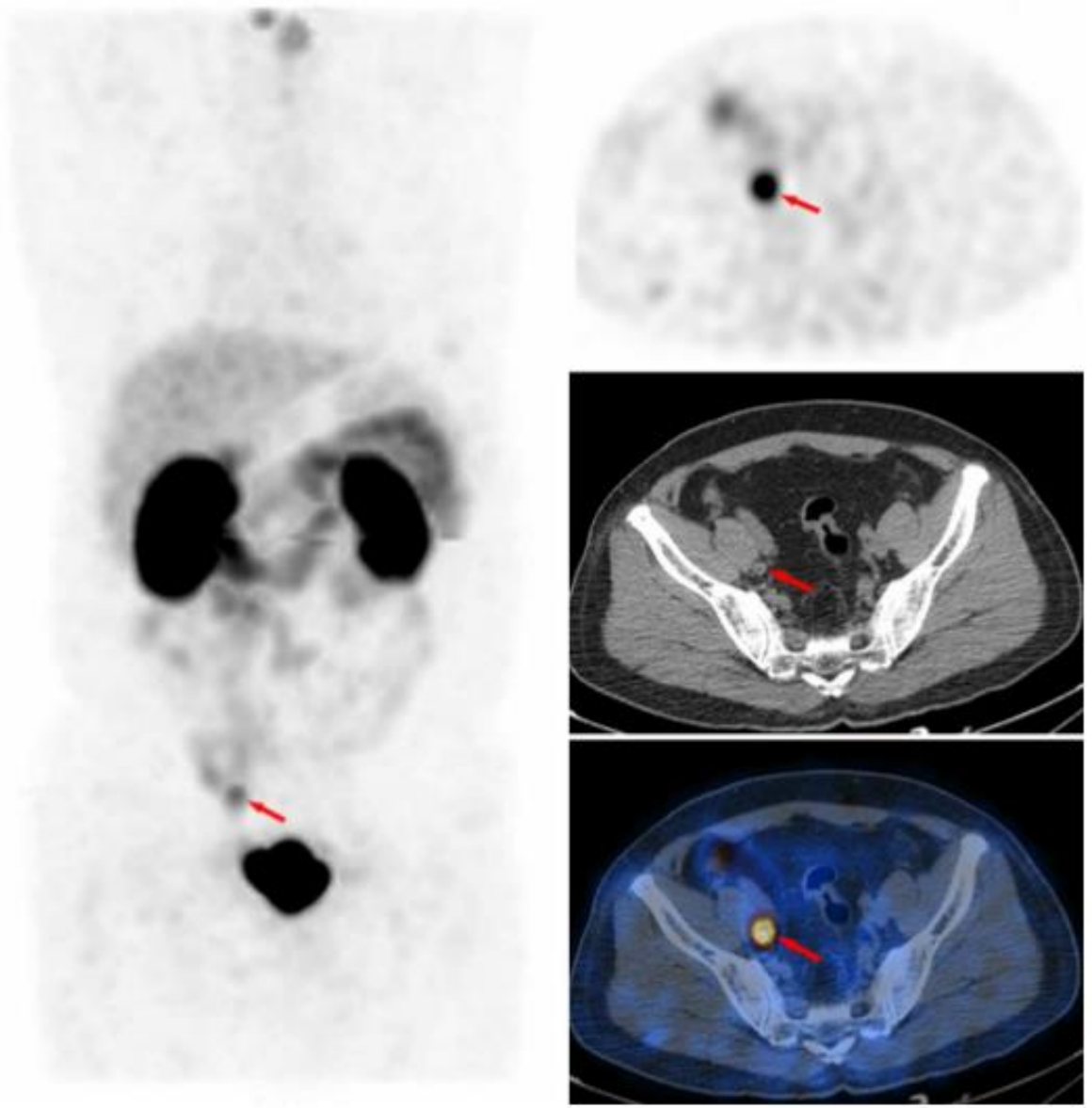
Interpretation?
How does it change management?



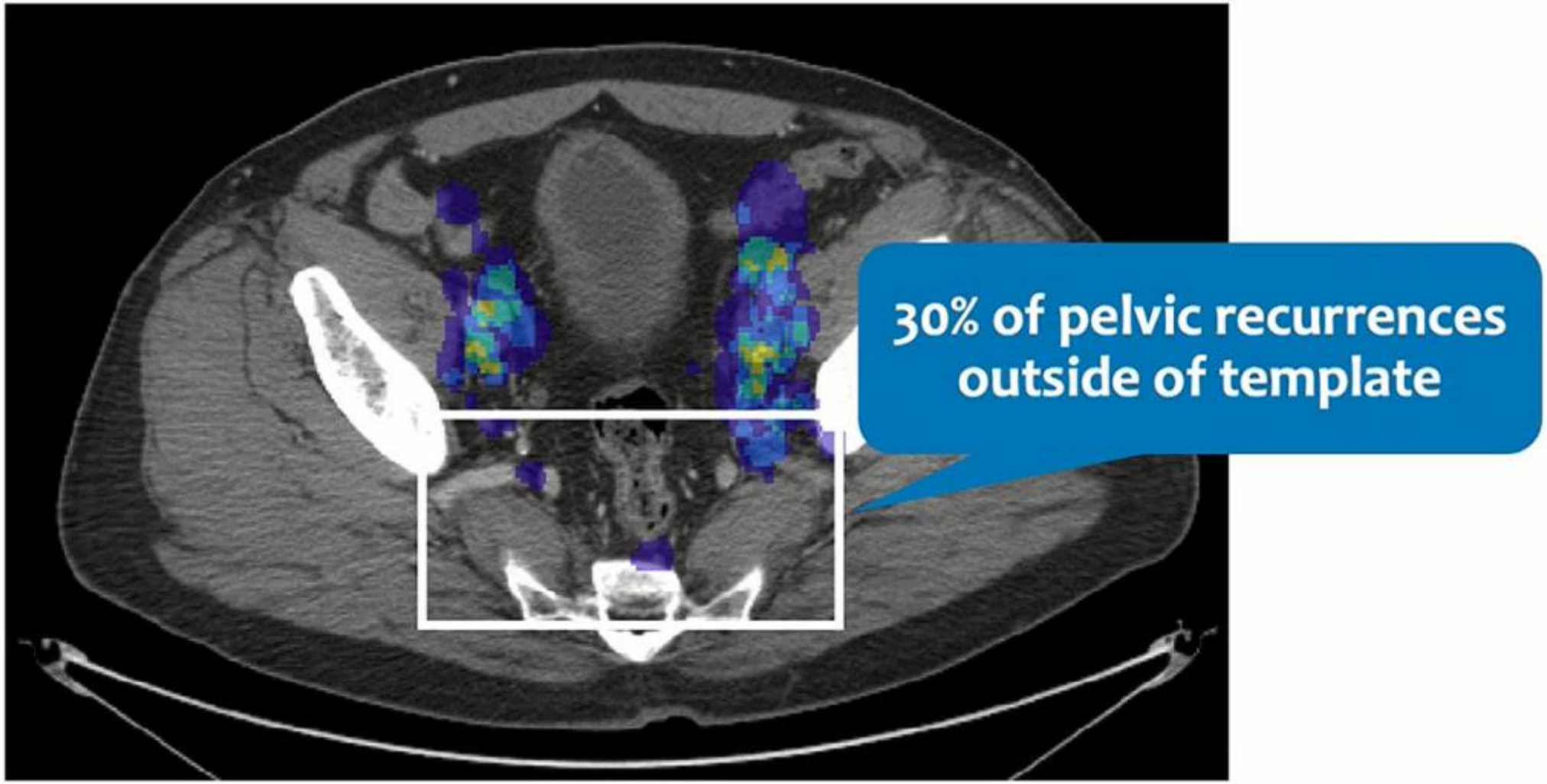
Another case

65 year old patient
4 years Post-RP
GS 5+4 (4/12 cores; IDC)
Initial PSA = 21
Referred for re-staging (PSA = 0.04)
Not seen on staging PSMA scan

Interpretation?
How does it change management?

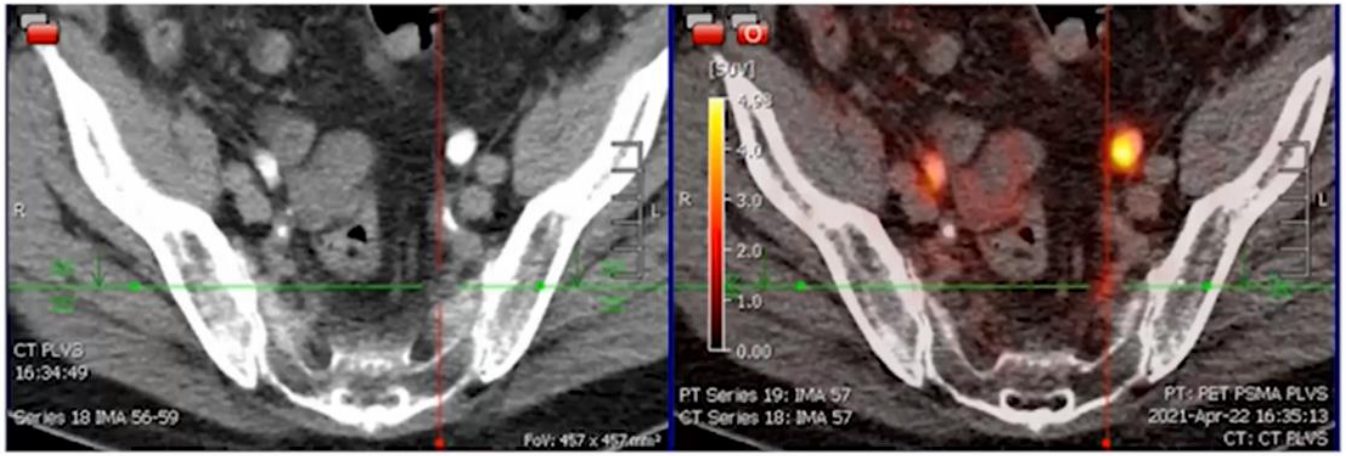


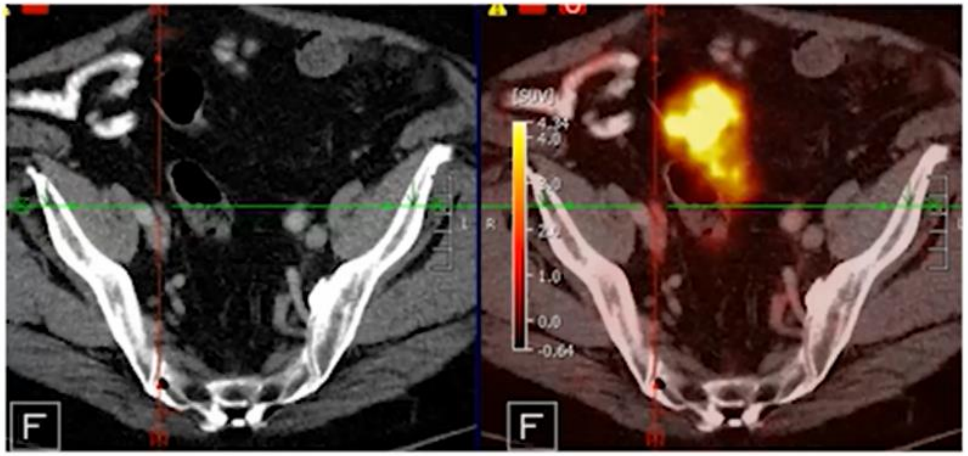
Sites of Lymph Node Metastases
Both in and outside of template

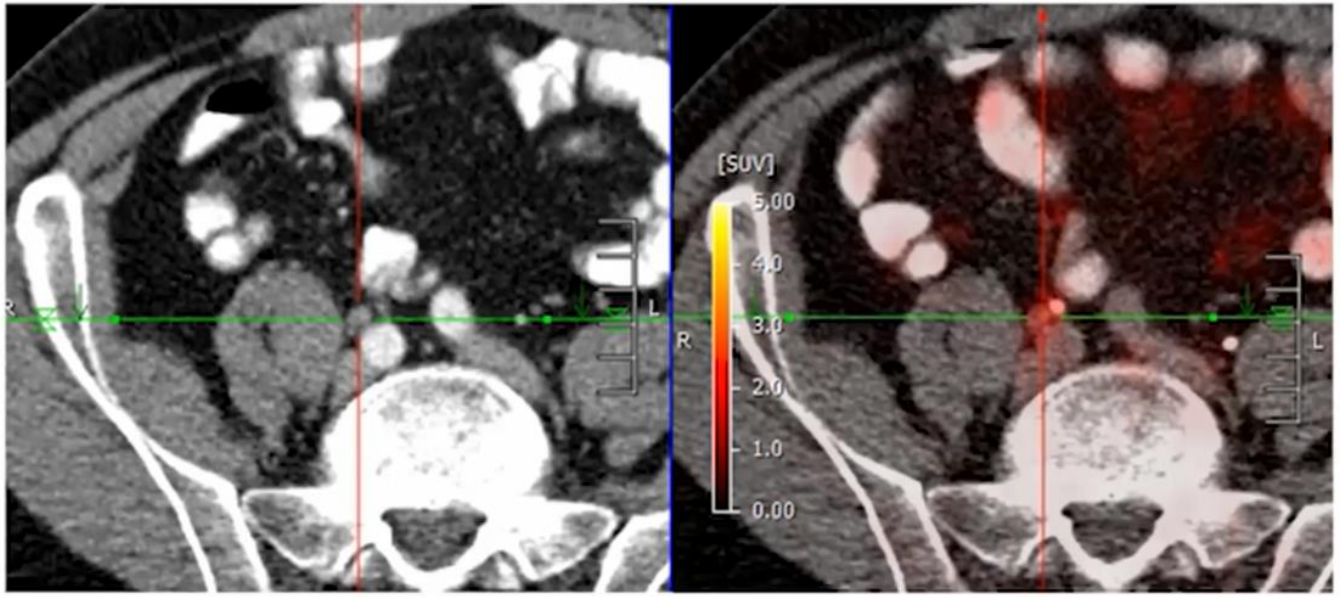


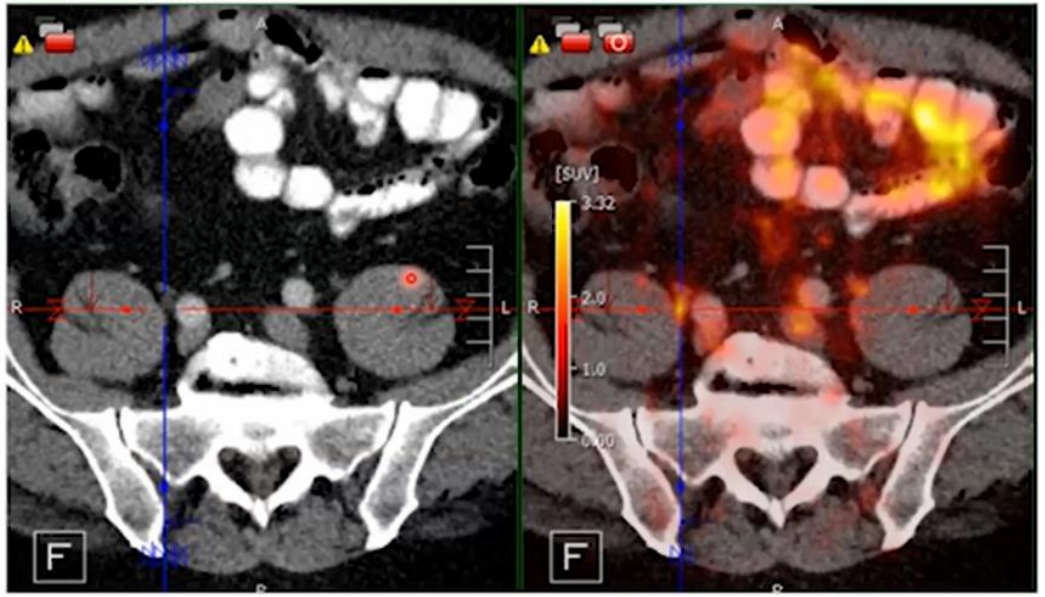
^{68}Ga-PSMA-11 PET/CT Imaging PITFALLS

FAINT UPTAKE Lymph Nodes –> False Positive or False Negative ?









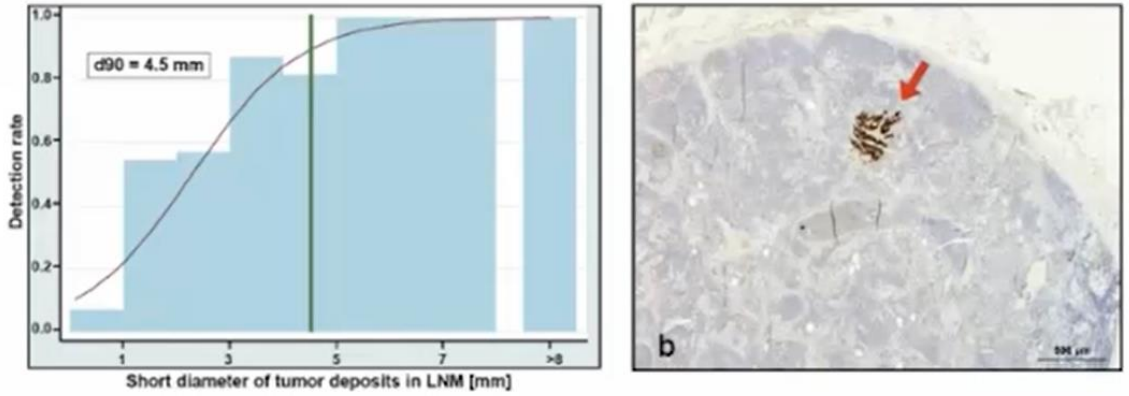
Size does matter !

Authors	Test results, number of patients or lesions				Sensitivity (95% CI)	Specificity (95% CI)
	true positive	false positive	false negative	true negative		
Cantiello F	7	0	1	15	0.88 (0.47–1.00)	1.00 (0.78–1.00)
van Leeuwen PJ (a)	12	1	10	157	0.55 (0.32–0.76)	0.99 (0.97–1.00)
van Leeuwen PJ (b)	7	1	4	18	0.64 (0.31–0.89)	0.95 (0.74–1.00)
Obek C	8	5	7	31	0.53 (0.27–0.79)	0.86 (0.71–0.95)
Budaus L	4	0	8	18	0.33 (0.10–0.65)	1.00 (0.81–1.00)
Maurer T	27	1	14	88	0.66 (0.49–0.80)	0.99 (0.94–1.00)
Herlemann A (a)	12	3	2	23	0.86 (0.57–0.98)	0.88 (0.70–0.98)
Herlemann A (b)	31	6	6	28	0.84 (0.68–0.94)	0.82 (0.65–0.93)
Herlemann A (c)	20	4	2	8	0.91 (0.71–0.99)	0.67 (0.35–0.90)
Combined					0.71 (0.59–0.81)	0.95 (0.87–0.99)

van Leeuwen PJ (a), lesion-based analysis.
van Leeuwen PJ (b), patient-based analysis.
Herlemann A (a), lesion-based analysis, primary LN dissection.
Herlemann A (b), lesion-based analysis, total LN dissection.
Herlemann A (c), patient-based analysis.

Metaanalysis (Kim et al., Urol Int. 2018)

Example: ^{68}Ga-PSMA-11: size dependent detection of LN metastases: 50%/90% at short axis diameters of >2.3mm/>4.5mm



N-category:
The Achilles tendon?

PSMA-ligand PET/CT detects more than **50% of lymph node metastases** with a short diameter of **at least 2.3 mm** and **more than 90%** of those with a short diameter of **at least 4.5 mm** in a salvage lymphadenectomy setting.

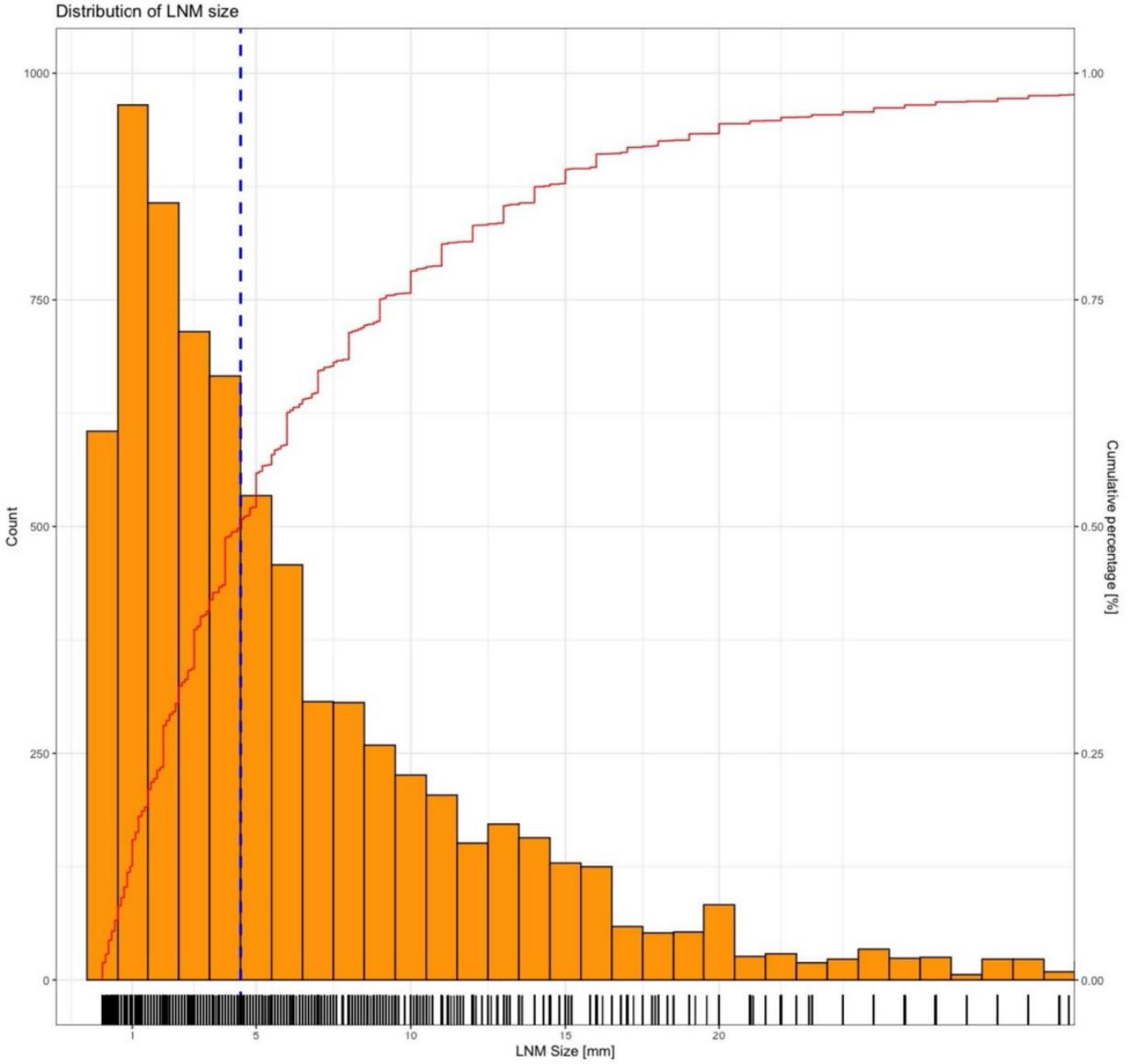


Fig. 1 Histogram and rug plot of LNM count according to size (individual and cumulative size distribution, n = 2705). Blue line = median size of LNM; red line = cumulative percentage of LNM with the size or smaller (i.e., 75% of all LNM are 10 mm or smaller). The count (orange bars) is reported in absolute numbers and the cumulative percentage (red line) as a percentage (%)

Eiber, JNM 2018

Falkenbach, World J Urol 2024

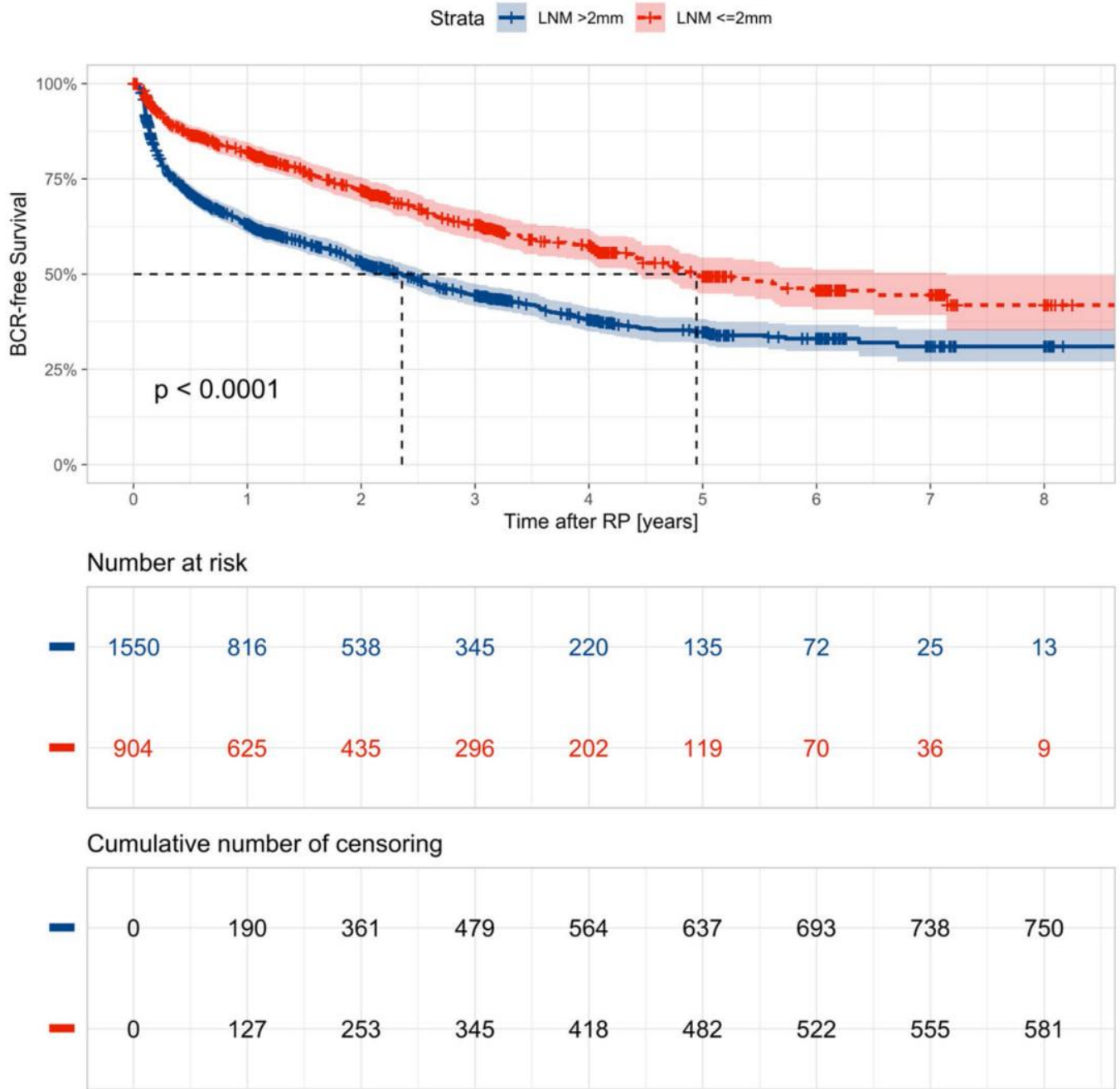
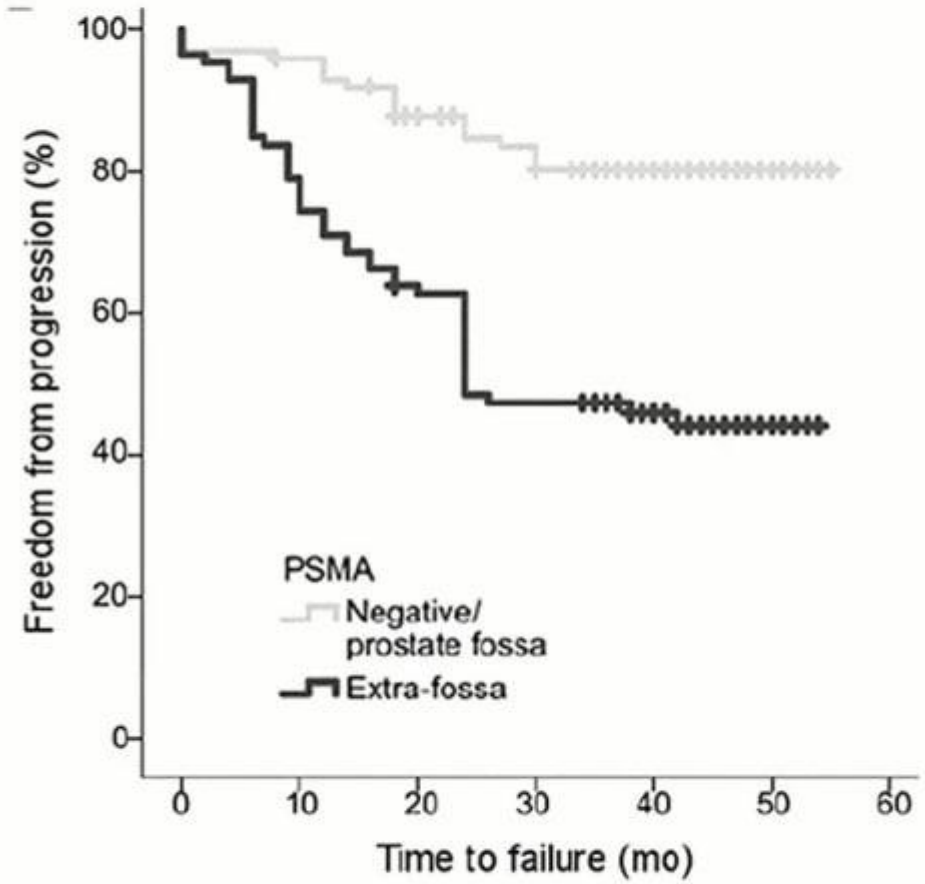


Fig. 2 Kaplan–Meier analyses depicting biochemical recurrence–free survival rates in 2454 patients (all patients with follow-up) treated with RP, subdivided by patients with micrometastases-only (LNMs ≤ 2 mm) versus patients with at least one LNM > 2 mm

PSMA PET imaging for BCR

PSMA PET N0 PREDICTIVE OF SRT OUTCOME



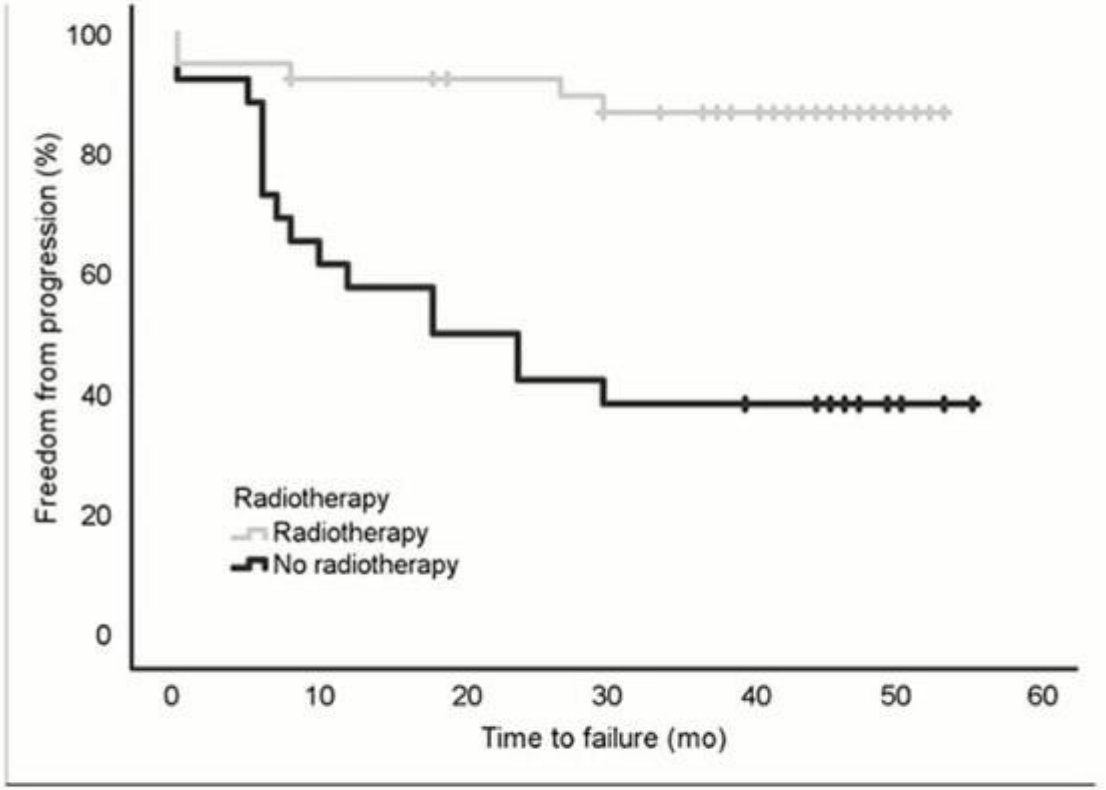


FIGURE 3. FFP in men with negative scan results who underwent sRT vs. men who were observed over 3 y ($P < 0.0001$).

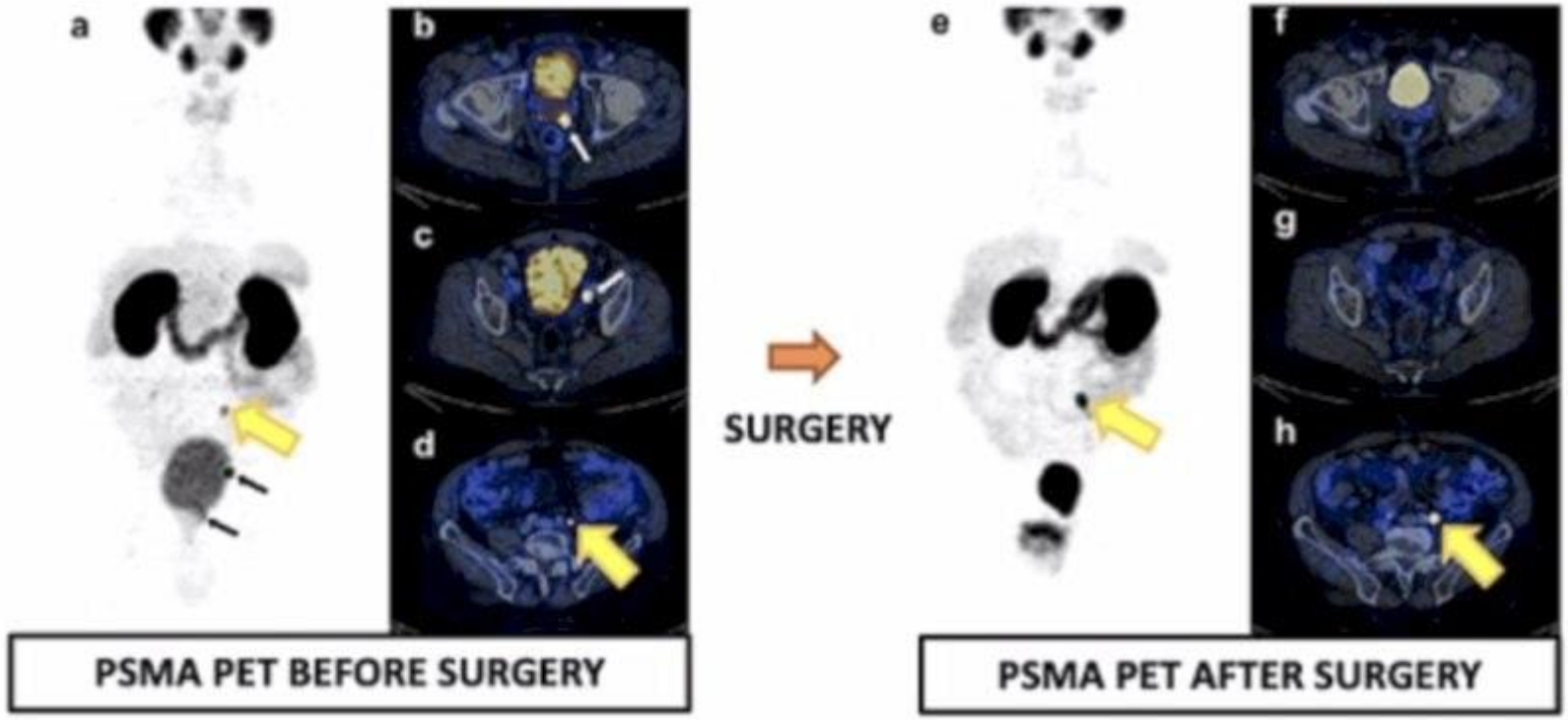
n= 260

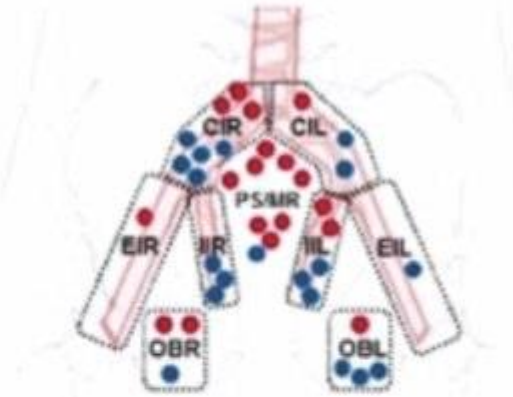
Emmett et al. *J Nucl Med* 2020

PSMA PET imaging for patient stratification

PSMA PET N status predictive value before PLN therapy

- A NEGATIVE N0 PSMA PET SCAN DOES NOT EXCLUDE N1 MICROSCOPIC DISEASE
- A NEGATIVE N0 PSMA PET SCAN IS PROGNOSTIC OF BETTER OUTCOME AFTER LOCAL THERAPY
- A NEGATIVE N0 PSMA PET SCAN MUST NOT PRECLUDE LOCAL THERAPY IF INTENDED FOR CURE





II	Internal iliac	Left/Right
EI	External iliac	Left/Right
CI	Common iliac	Left/Right
OB	Obturator	Left/Right
PS/MR	Presacral/Mesorectal	

● Persistent region
● Recurrent region

Nguyen, Antaris, van den Berg, Xue, Greenberg, Muchnik, Klaassen, Simko, Dutta, Sorger and Carroll
Do not cite or reproduce

UCSF
Department of Urology

Case #3

- A 57-year-old male patient with a family history of metastatic prostate cancer
- presents with a PSA level of 26 ng/mL.
- A biopsy reveals a Gleason score of 4+3 in 8 out of 12 cores.
- The patient has been referred for staging.
- He complaints of back pain.

57 year old

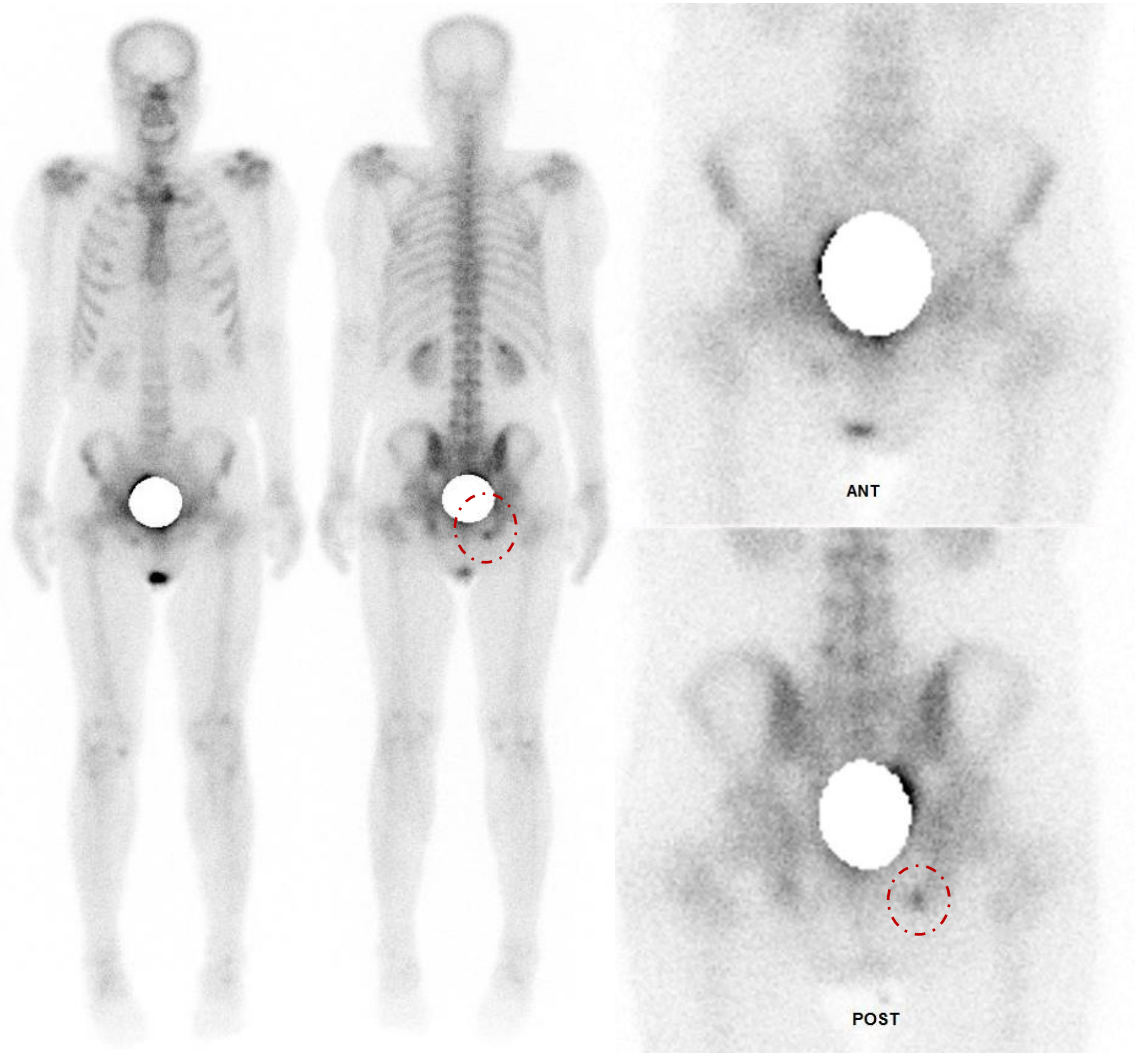
GS 4+3

PSA 26

Back pain

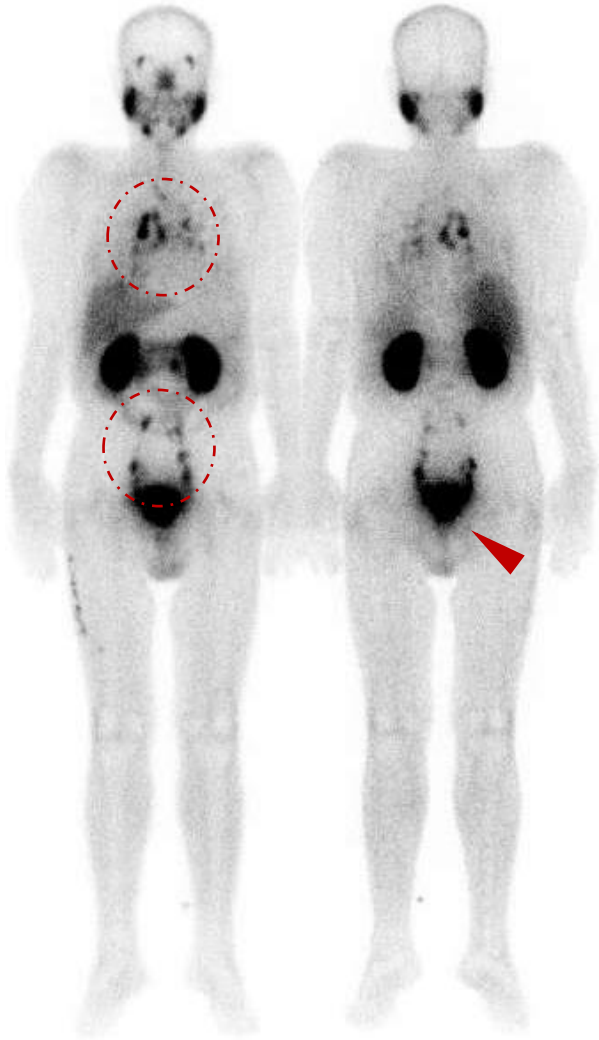
Referred for staging

$M_{1b?}$



Correlation with PSMA SPECT/CT

$M_{1a}M_{1b}$



The PSMA SPECT/CT report indicates a staging classification of miT3bN2M1a.

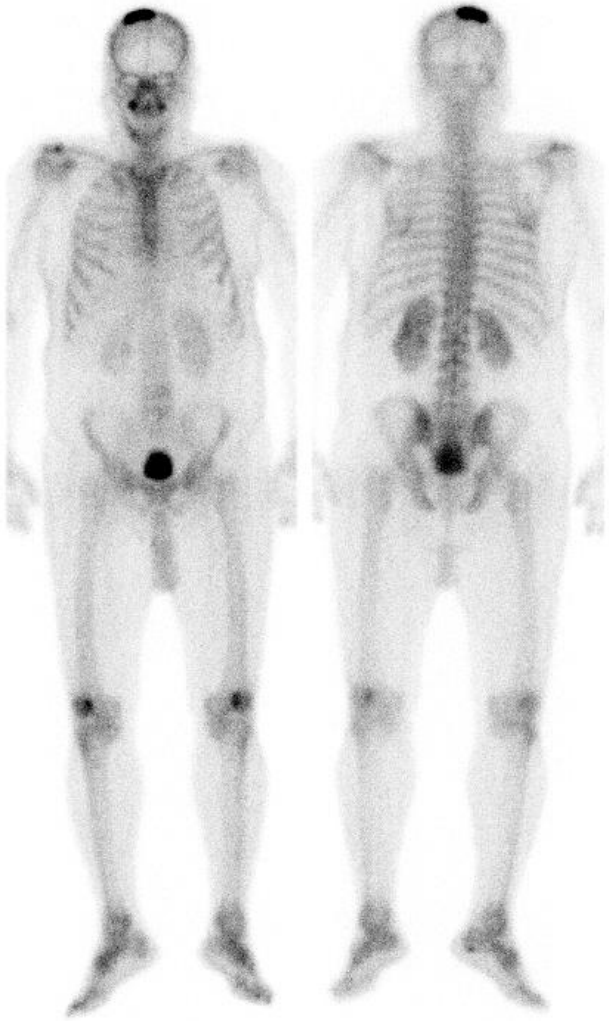
Another case

57 year old

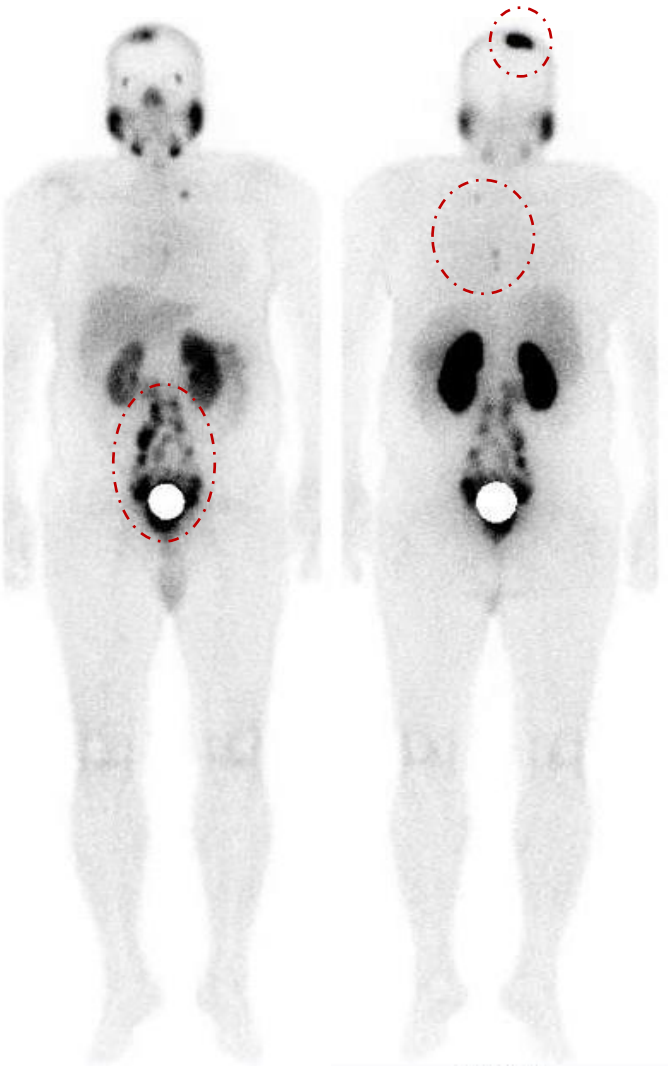
GS 5+4

PSA 26.2

Referred for staging

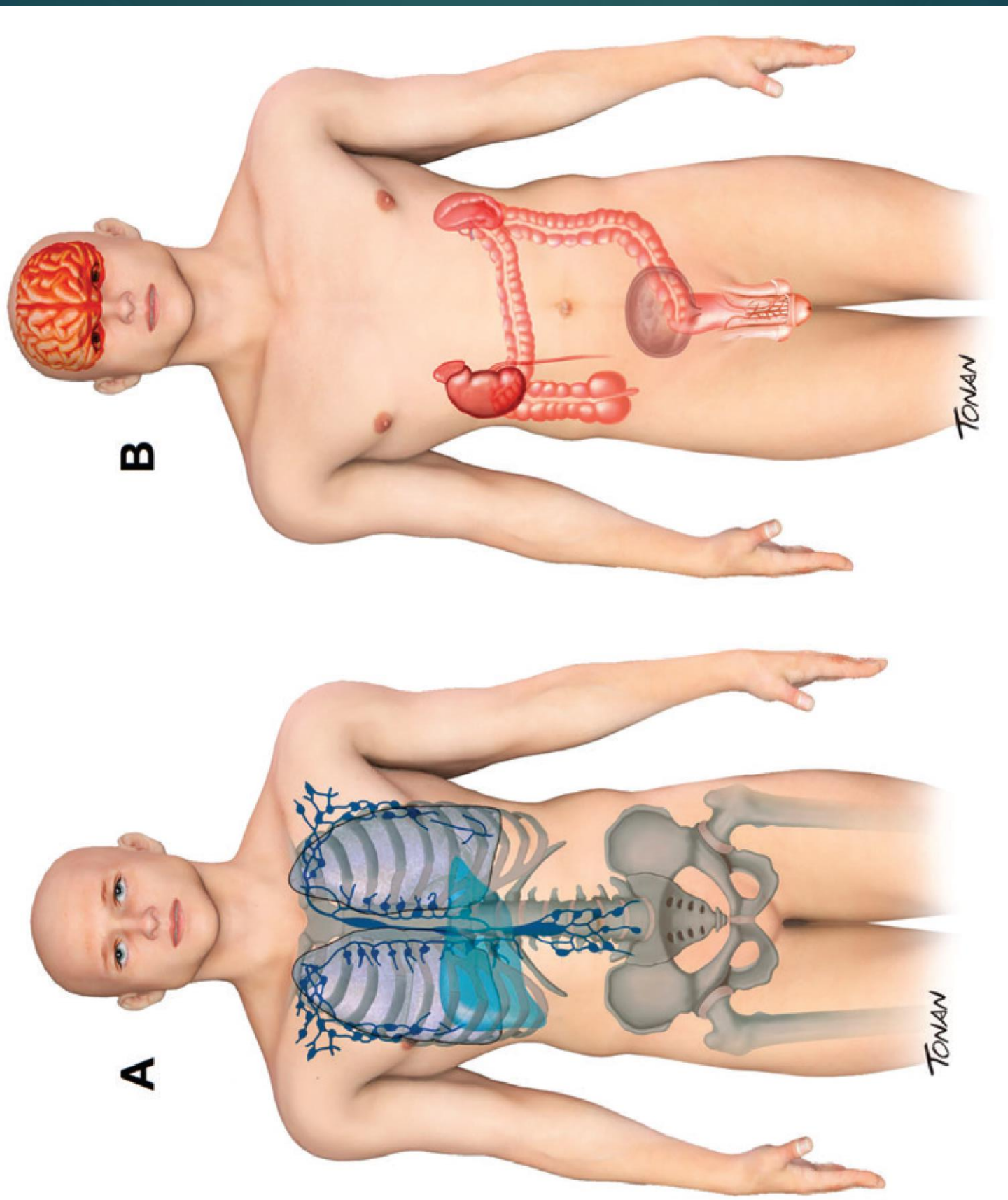


Correlation with PSMA SPECT/CT



Typical vs. Atypical

Barbosa FG. Radiographics. 2019; 39(1):186-212.

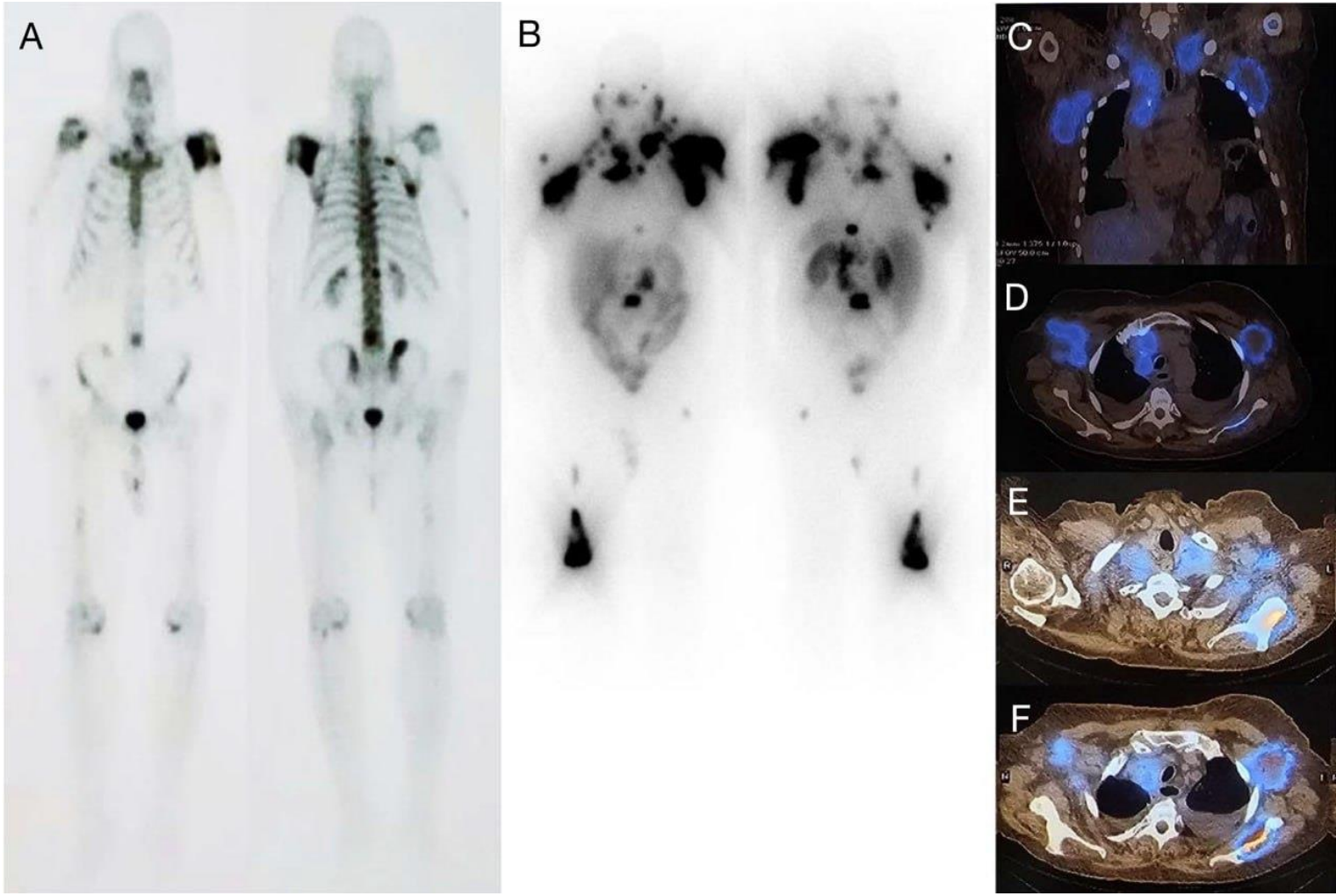


Tumor lysis syndrome following ^{177}Lu-PSMA therapy

- 65-year-old mCRPC
- Post-ARPI, post-taxane
- Metachronous M1 (high-volume)
- Multiple bone mets
- Bilateral bulky LNMets
- Kanofsky PS = 80%

❑ Following 2 PSMA-RLT cycles:

- **LDH rise from 339 to 543000!**
- **Gait disorder**



Sahafi, CNM 2024

Case #3 (Cont.)

Questions:

- Do you recommend surgery for this patient? Under what circumstances would the patient not be considered a good candidate for surgical intervention?
- Would you consider radiotherapy (RT) for this patient? If so, what is the typical extent of the RT field in such cases?

PSMA report templates

- ✓ ***E-PSMA (ver. 1)***
- ✓ ***PROMISE (ver. 2)***
- ✓ ***PSMA-RADS (ver. 2)***

European Association of Urology

Review – Prostate Cancer

Second Version of the Prostate Cancer Molecular Imaging Standardized Evaluation Framework Including Response Evaluation for Clinical Trials (PROMISE V2)

Robert Seifert[a,*], *Louise Emmett*[b], *Steven P. Rowe*[c,d], *Ken Herrmann*[a,e], *Boris Hadaschik*[f], *Jeremie Calais*[e], *Frederik L. Giesel*[g], *Robert Reiter*[h], *Tobias Maurer*[i,j], *Matthias Heck*[k,l], *Andrei Gafita*[e,‡], *Michael J. Morris*[m], *Stefano Fanti*[n], *Wolfgang A. Weber*[o], *Thomas A. Hope*[p], *Michael S. Hofman*[q,r], *Wolfgang Peter Fendler*[a,s,†], *Matthias Eiber*[l,o,†]

European Journal of Nuclear Medicine and Molecular Imaging (2021) 48:1626–1638
https://doi.org/10.1007/s00259-021-05245-y

GUIDELINES

E-PSMA: the EANM standardized reporting guidelines v1.0 for PSMA-PET

Francesco Ceci[1] · Daniela E. Oprea-Lager[2] · Louise Emmett[3,4] · Judit A. Adam[5] · Jamshed Bomanji[6] · Johannes Czernin[7] · Matthias Eiber[8] · Uwe Haberkorn[9] · Michael S. Hofman[10,11] · Thomas A. Hope[12] · Rakesh Kumar[13] · Steven P. Rowe[14] · Sarah M. Schwarzenboeck[15] · Stefano Fanti[16] · Ken Herrmann[17]

European Association of Urology

Platinum Priority – Prostate Cancer
Editorial by XXX on pp. x–y of this issue

Prostate-specific Membrane Antigen Reporting and Data System Version 2.0

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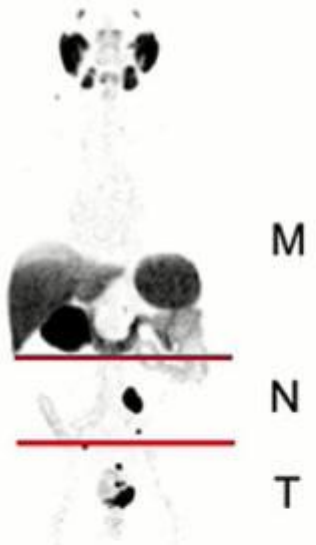
Overview on frameworks of standardized reporting

Different systems for standardized reporting have been proposed

PROMISE

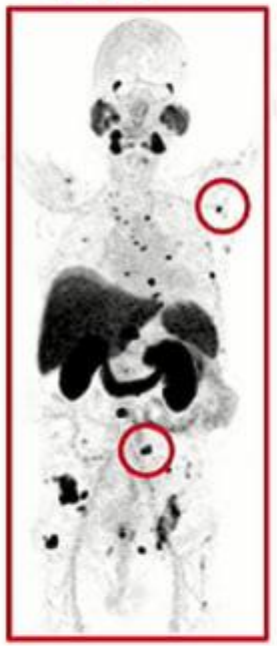


describes the extent of disease (miTNM)

PSMA-Rads

evaluates the nature of a lesion

PPP

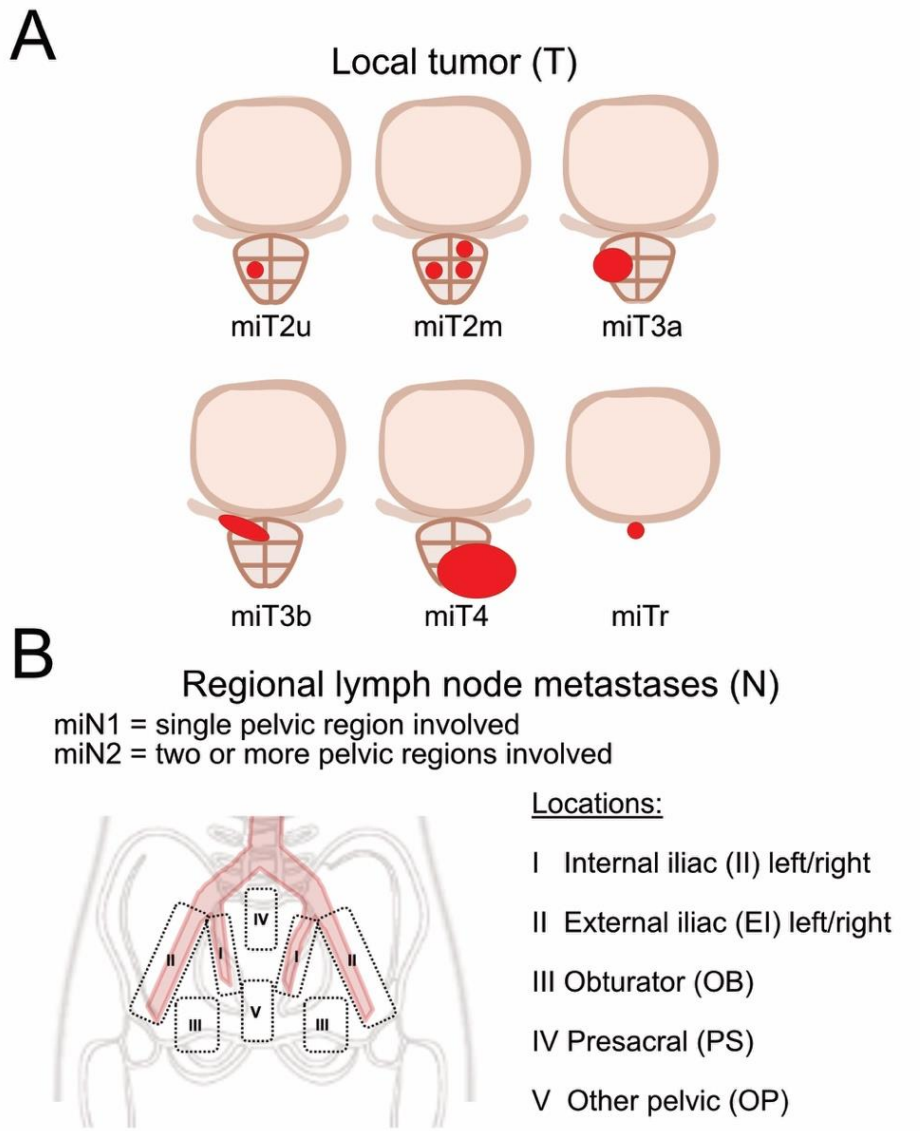


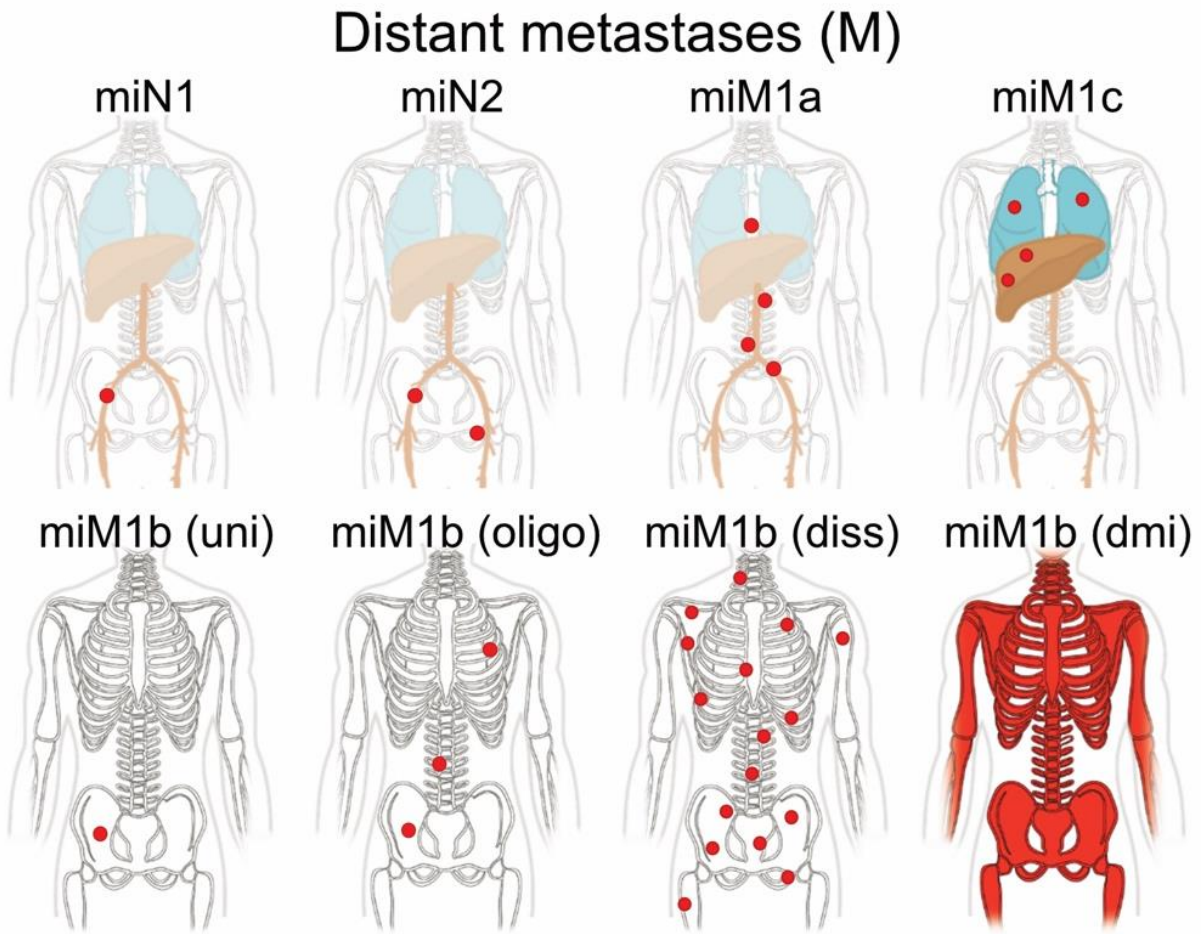
discriminates PD from non-PD

RECIP

assessment of response vs. progression on different levels

PROMISE ver. 2 (miTNM)





Seifert, Eur Urol 2023

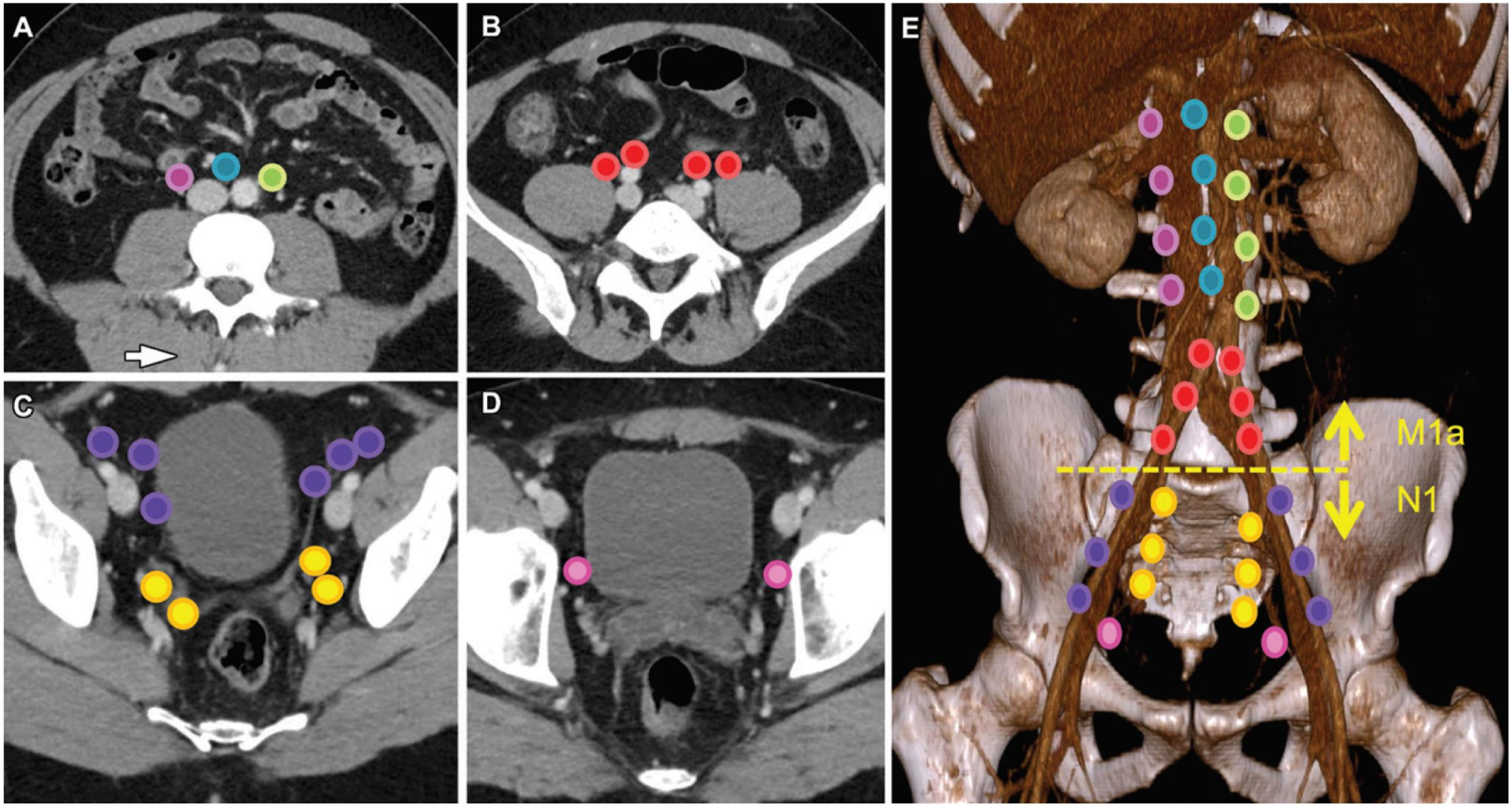
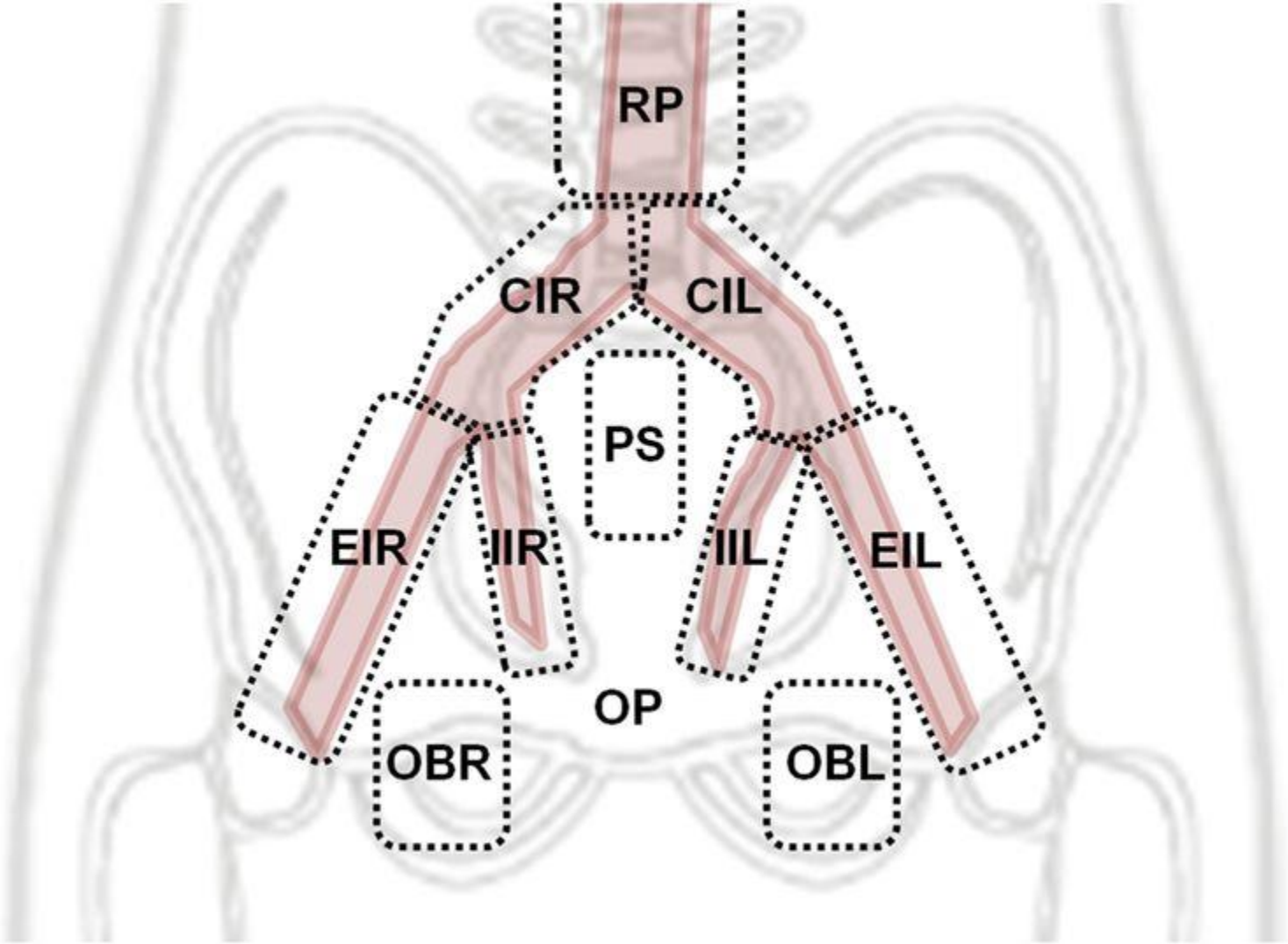


Figure 12. Typical nodal spread pattern of prostate cancer, arising from caudal pelvic lymph nodes on an ascending pathway toward the retroperitoneum *(E)*. The most prevailing nodal metastases occur at the obturator station (pink), followed by the external iliac (purple), internal iliac (yellow), common iliac (red), and retroperitoneal stations (violet = pericaval, blue = aortocaval, green = periaortic), in decreasing order of prevalence. Note that lymph nodes above the bifurcation of the common iliac vessels are regarded as nonregional and therefore staged as M1a in the TNM system.

Patterns of Recurrence
Barbosa FG. Radiographics. 2019; 39(1):186-212.



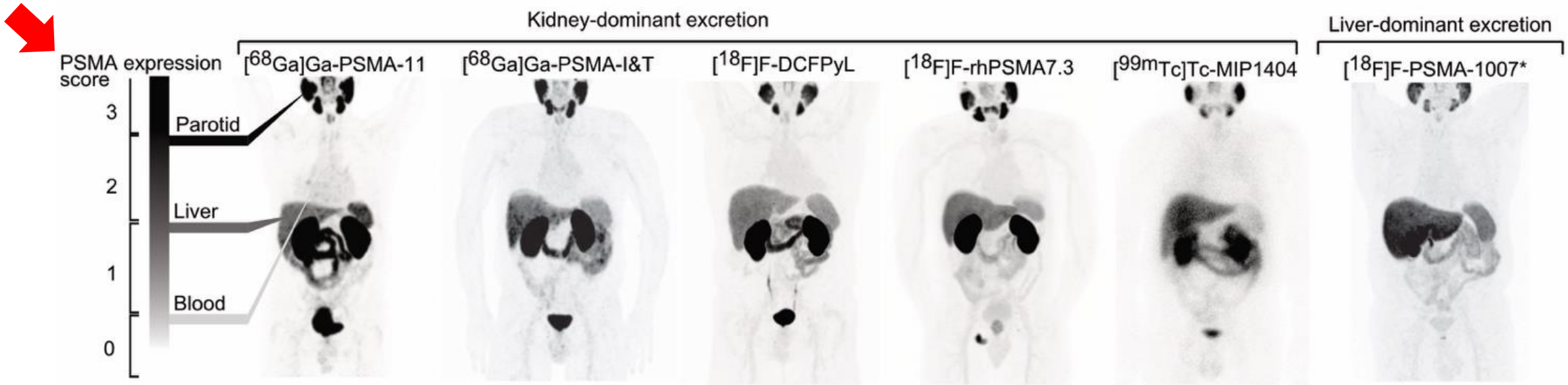
II	Internal iliac	Left/Right
EI	External iliac	Left/Right
CI	Common iliac	Left/Right
OB	Obturator	Left/Right
PS	Presacral	
OP	Other pelvic	
RP	Retroperitoneal	

miN boundaries

miNa/b template	Anatomical boundaries
Internal iliac (II)	bifurcation internal/external iliac arteries, pelvic floor, bladder wall, obturator nerve
External iliac (EI)	bifurcation internal/external iliac arteries, circumflex iliac vein and endopelvic fascia, psoas muscle and genitofemoral nerve and medial border external iliac artery
Common iliac (CI)	aortic bifurcation, bifurcation internal/external iliac arteries, psoas muscle and genitofemoral nerve and medial border common iliac artery
Obturator (OB)	bifurcation internal/external iliac arteries, pelvic floor, obturator nerve, and medial border external iliac artery
Presacral (PS, aka: presciatic)	Triangle between medial borders of common iliac arteries and line connecting internal/external iliac arteries' bifurcations; dorsal border: promontory and proximal sacrum (S1–S2)

Supplemental Table 1: Description of anatomical delineation of pelvic lymph node territories (adapted from Joniau et al; Nicolau et al.)

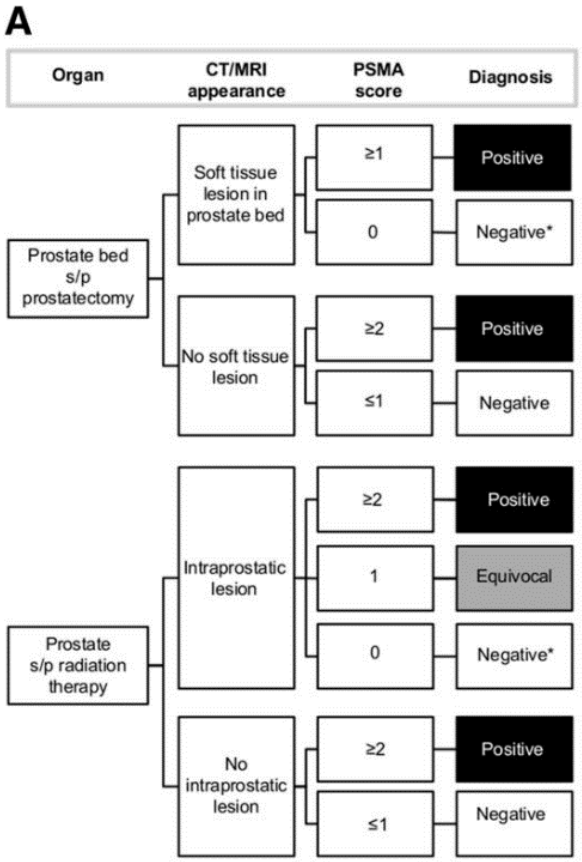
PROMISE ver. 2 & new approved agents



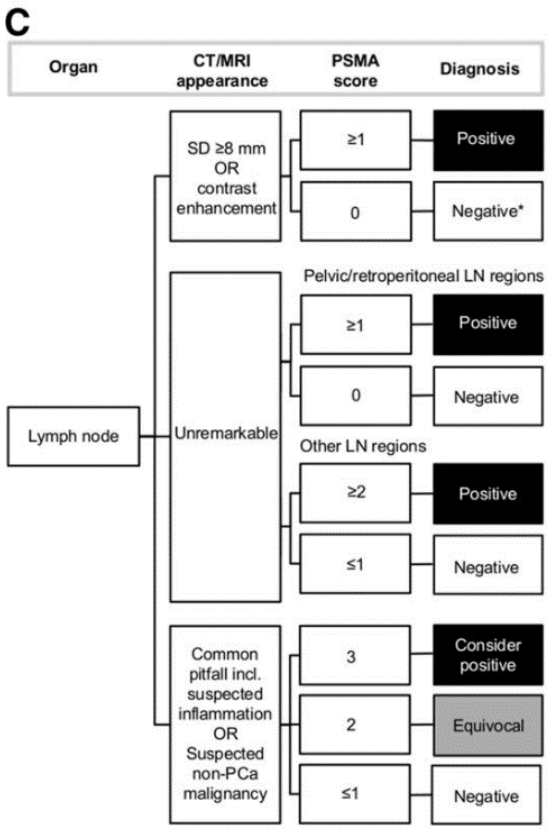
	[68Ga]Ga-PSMA-11	[68Ga]Ga-PSMA-I&T	[18F]F-DCFPyL	[18F]F-rhPSMA7.3	[99mTc]Tc-MIP1404	[18F]F-PSMA-1007*
FDA approval?	☑ [Locametz, Illuccix]	☒	☑ [Pylarify]	☑ [Posluma]	☒	☒
Rec. by guidelines?	☑	☑	☑	☑	☑ [for RLT]	☑
Available in Iran?	☑				☑ [99mTc-HYNIC-PSMA]	?
Accuracy?	High	High	High	High	Moderate	High
Weakness?	**Prostate bed**	Prostate bed	Prostate bed		Prostate bed	UBU, Liver
Cost?	Mod. (cost-effective)				**Low**	

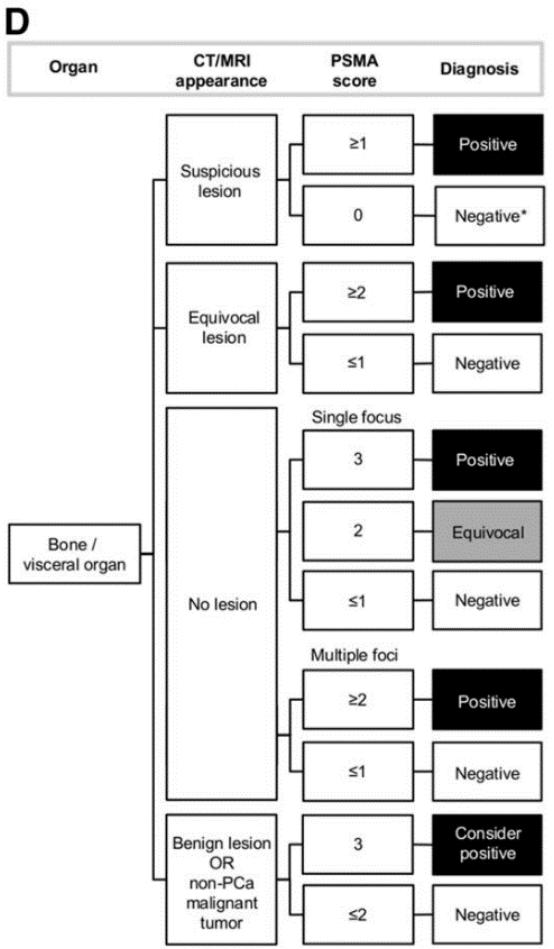
Seifert, Eur Urol 2023

PROMISE ver. 1



Later (ver. 2) Substituted by PRIMARY score

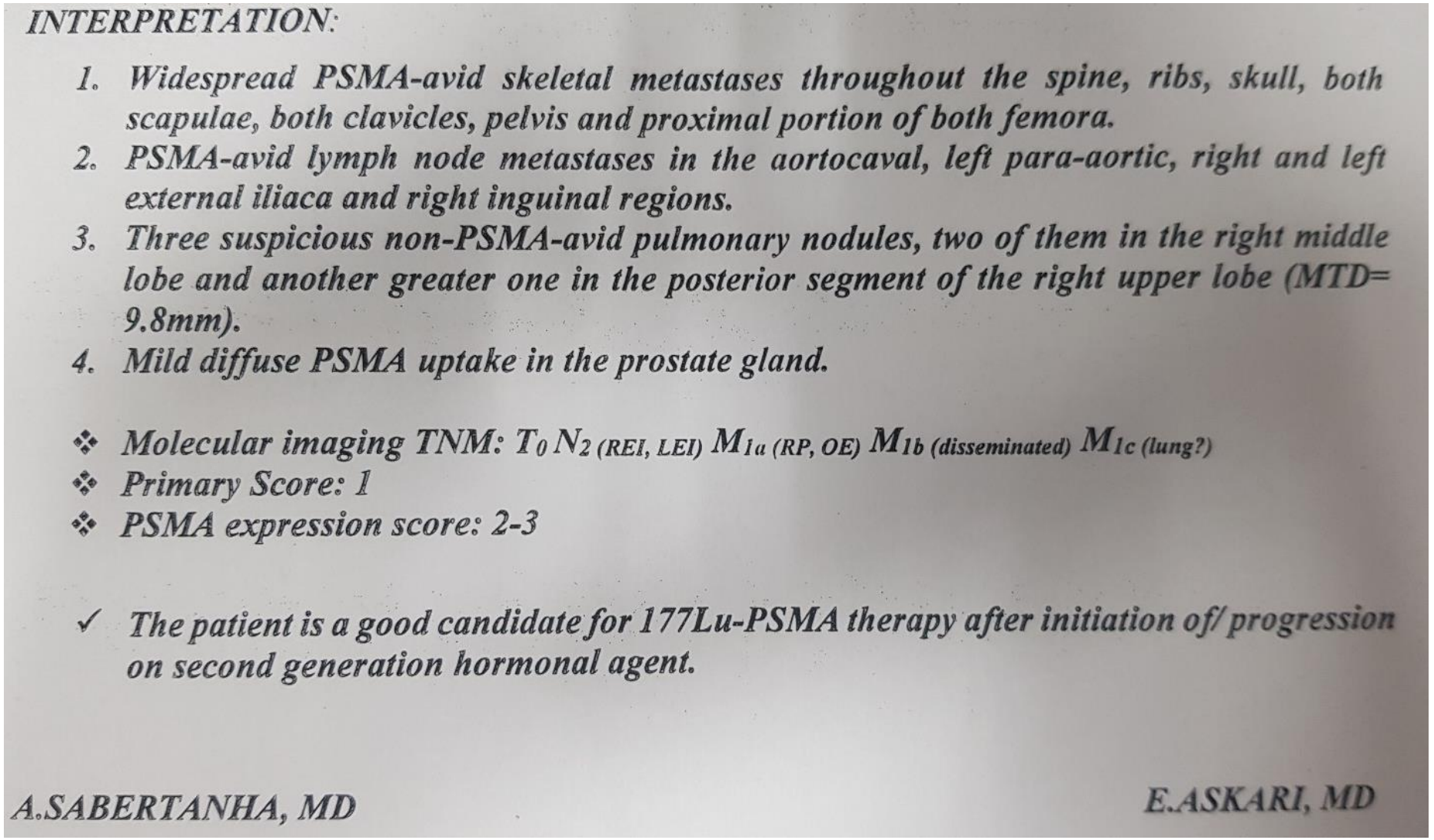




s/p = status post. *Consider PSMA-ligand–negative prostate cancer.

Eiber, JNM 2018

An example for miTNM reporting



INTERPRETATION:

1. *Widespread PSMA-avid skeletal metastases throughout the spine, ribs, skull, both scapulae, both clavicles, pelvis and proximal portion of both femora.*
2. *PSMA-avid lymph node metastases in the aortocaval, left para-aortic, right and left external iliaca and right inguinal regions.*
3. *Three suspicious non-PSMA-avid pulmonary nodules, two of them in the right middle lobe and another greater one in the posterior segment of the right upper lobe (MTD= 9.8mm).*
4. *Mild diffuse PSMA uptake in the prostate gland.*

- *Molecular imaging TNM: $T_0 N_{2\,(REI,\,LEI)} M_{1a\,(RP,\,OE)} M_{1b\,(disseminated)} M_{1c\,(lung?)}$*
- *Primary Score: 1*
- *PSMA expression score: 2-3*

✓ *The patient is a good candidate for 177Lu-PSMA therapy after initiation of/ progression on second generation hormonal agent.*

A.SABERTANHA, MD *E.ASKARI, MD*

This framework may also be applied for PSMA-ligand PET/MRI, SPECT/CT, or similar approaches.

Eiber, JNM 2018

Certainty of Diagnosis: The issue of the past?

Certainty and Final Diagnosis

Certainty	Diagnosis
Consistent with	Positive
Suggestive of	Positive
Possible	Equivocal
Unlikely	Negative
No evidence of disease	Negative

Final diagnosis should be reported as positive or negative for prostate cancer. Equivocal diagnosis should be used only when alternative techniques are available that may reasonably provide clarification.

Eiber, JNM 2018

PROMISE: Details (ROIs & T-Category)

- **ROIs** (all in **axial** planes):
  - ✓ **Liver**: *3 cm, normal parenchyma, inferior right lobe*
  - ✓ **Blood pool**: *2 cm, aortic arch*
  - ✓ **Parotid**: *1.5 cm, right parotid*
  - ✓ **Prostate**: *1 cm, maximum voxel (uptake)*
- **Faint uptake** in the **prostate gland**:
  - ✓ **After RT: Physiologic BKG**
  - ✓ After RP: highly suggestive
  - ✓ Post RP/RT with no uptake? **miT0**
- **Apex/Mid/Base? 1/3, 1/3, 1/3**
- **Bladder involvement: PSMA expression score > bladder neck/urethra** *OR* **typical MRI (enhancement, diffusion restriction)** *OR* **CT (enhancement)** *OR* **Gross EPE**

Eiber, JNM 2018

PROMISE: Details (N-Category)

- For **N/M1a,** CT and MRI abnormalities (*additional morphologic criteria*):
  - ✓ **regional grouping**
  - ✓ **loss of fatty hilum**
  - ✓ **focal necrosis**
- For **M1b**, common CT/MRI findings include:
  - ✓ **Sclerotic**
  - ✓ **Lytic** lesions (rare) ± **extraosseous extension**
  - ✓ **Low signal on unenhanced T1-weighted images**

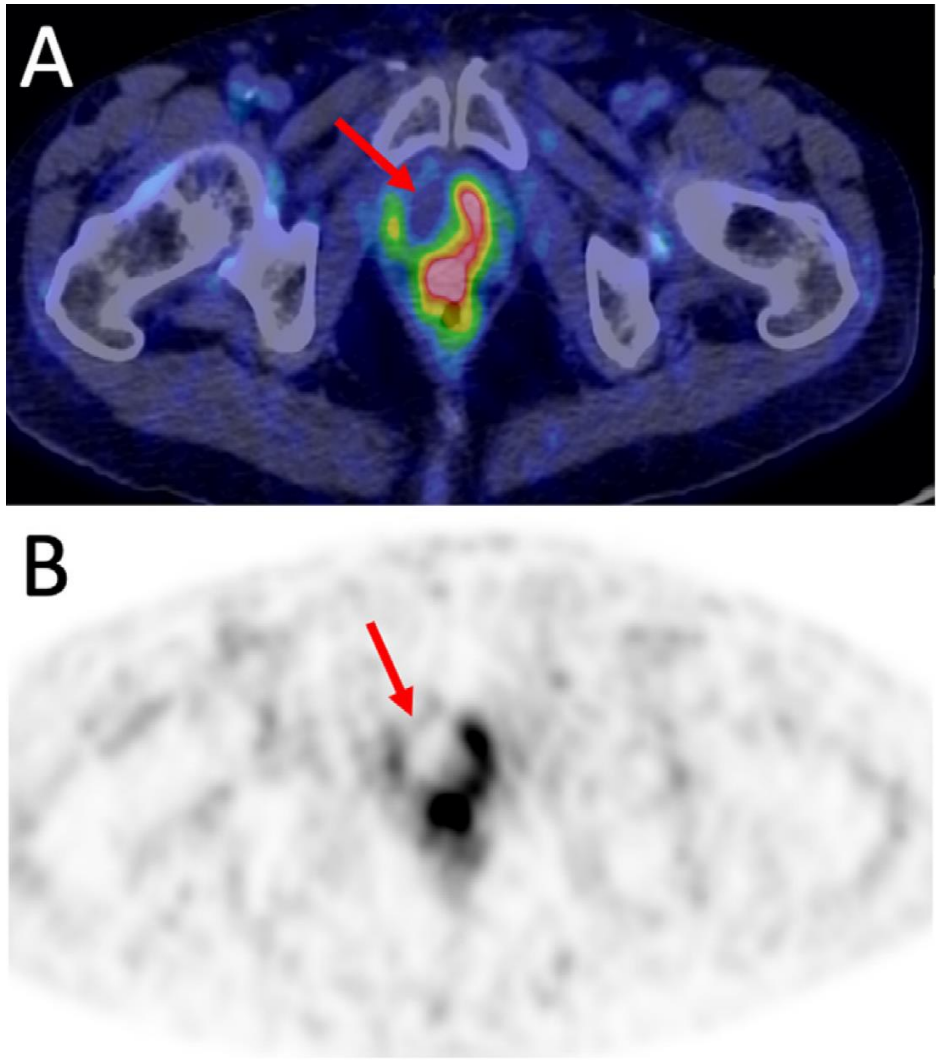
Eiber, JNM 2018

Not all prostate cancers are PSMA-avid

[5-10% of PCa patients are PSMA-negative]

DDx of a non-PSMA-avid lesion:

1. **Neuroendocrine subtype**
2. **Recent ADT**
3. **Ductal subtype**
4. *Splice variants*
5. Too small lesions
6. Artifactual
   - I. Halo artifact
   - *II. QC error*
     - *a) Free TcO_4*
     - *b) Radiolysis*
   - III. Inappropriate color scale
   - IV. Intraprostatic seeds
   - V. Masked by urine activity



Beware!

These are **usually NECs not NETs**!

Sahafi, CNM 2024

Mei, Semin Nucl Med 2021

Case #3 (Cont.)

Management and Outcomes:

- The patient undergoes radical prostatectomy. The pathological examination shows involvement of the seminal vesicles and metastasis to four lymph nodes out of fifteen resected nodes. The surgical margins are negative.

Postoperative PSA Monitoring:

- The first postoperative PSA measurement was taken approximately seven weeks after surgery, revealing a level of 0.4 ng/mL. A subsequent measurement showed a PSA level of 0.45 ng/mL.

Next Steps:

- What should be the next step in management?

Additional Concepts:

- What is the difference between biochemical progression (BCP) and biochemical recurrence (BCR)?

Pre-aortic, aortocaval and precaval are…

M1a

AJCC 8th Edition Prostate Pelvic Anatomy and Nodal Disease: "Regional Nodes" below the aortic bifurcation

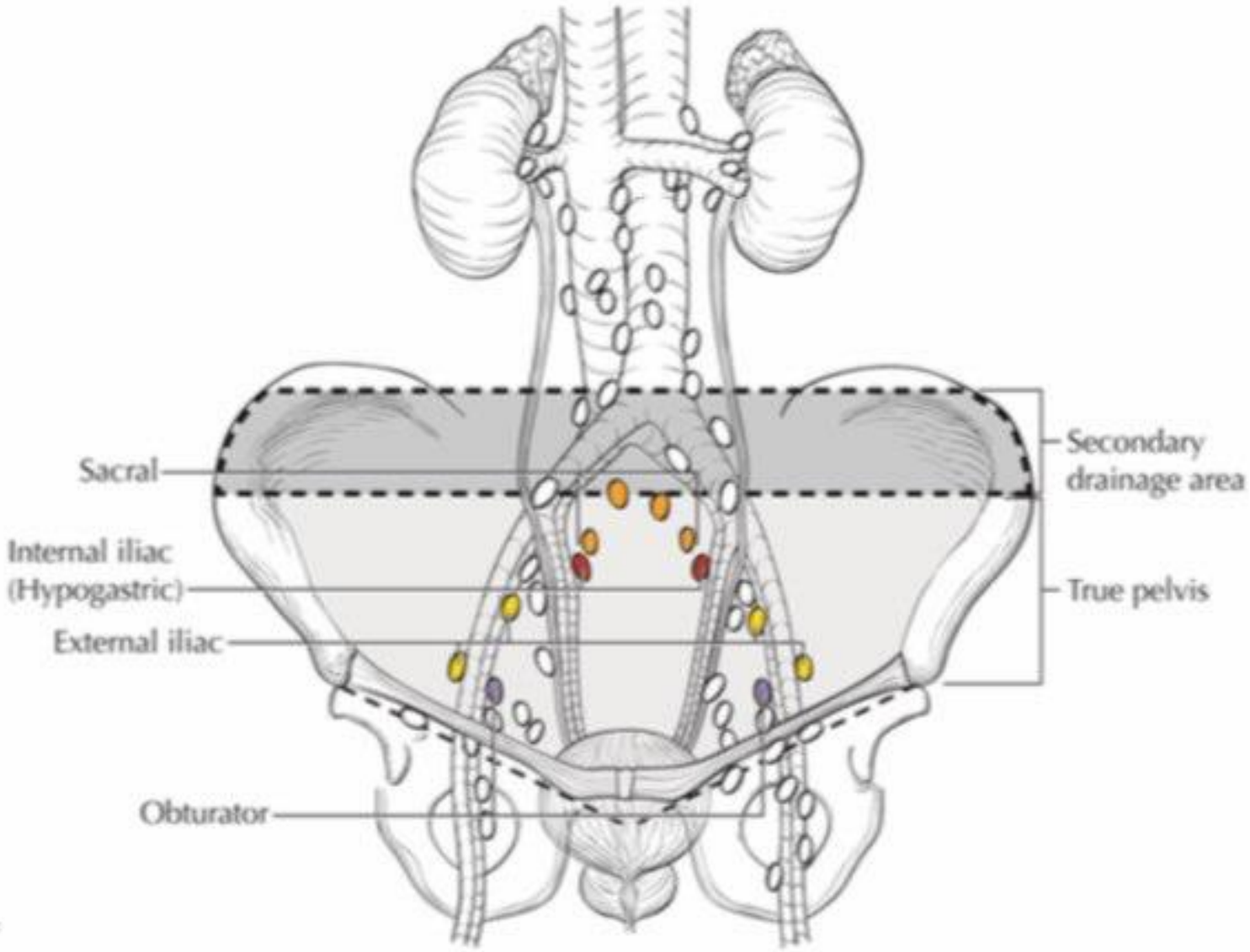


TABLE 1: Regional and Nonregional Lymph Nodes in Common Pelvic Cancers

Nodes	Location of Cancer					
	Prostate	Testis	Ovary	Cervix	Endometrium	Bladder
Perivisceral	Regional	Regional	Regional	Regional[a]	Regional	Regional
Paraaortic	Nonregional	Regional	Regional	Nonregional	Regional	Regional
Common iliac	Nonregional[b]	Nonregional[c]	Regional	Regional	Regional	Regional
External iliac	Regional	Nonregional[c]	Regional	Regional	Regional	Regional
Internal iliac	Regional	Nonregional[c]	Regional	Regional	Regional	Regional
Inguinal	Nonregional	Nonregional[c]	Regional	Nonregional	Nonregional	Nonregional

Note—Data from [2] and [29].

[a]Perivisceral nodes for cervical cancer include paracervical and parametrial nodes.

[b]Common iliac lymph nodes represent secondary drainage lymph nodes in prostate cancer.

[c]Intrapelvic and inguinal nodes are considered regional only after inguinal or scrotal surgery [2].

BCP

[definition: PSA >0.1 ng/mL 4-8 wk post-op]

BCR

[definition:

Post-RP: ~~PSA >0.2 ng/mL (×2)~~ ↑PSA (×2) & prior undetectable

Post-RT: PSA ↑2 ng/mL above the nadir (×2)]

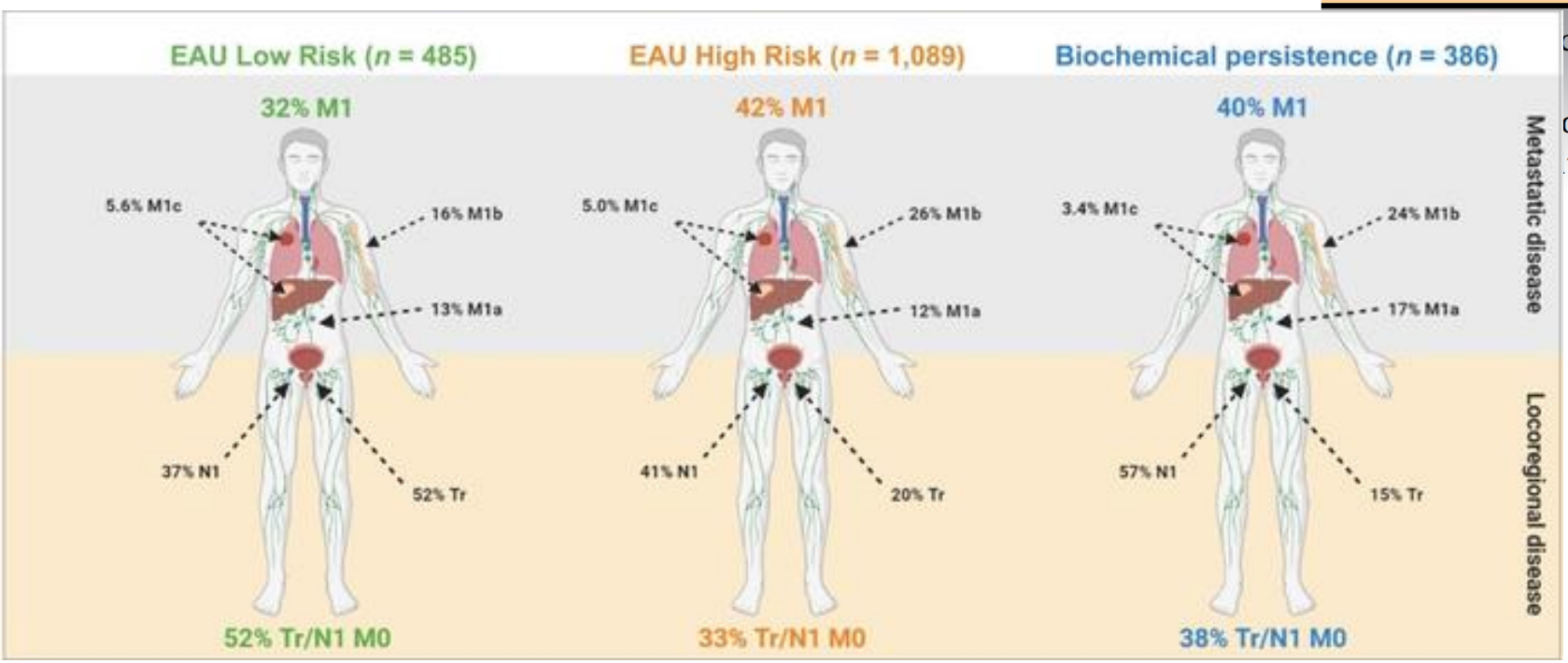
High-risk BCR (RP): PSA-DT <12m OR pGG4-5

High-risk BCR (RT): IBF <18m OR bGG4-5

Table 1 – Summary of the European Association of Urology low-risk and high-risk BCR definitions stratified by primary treatment.

Risk group	Characteristics
BCR after radical prostatectomy	
Low-risk BCR	PSA-DT >1 yr and pGS <8 (ISUP grade <4)
High-risk BCR	PSA-DT ≤1 yr or pGS 8–10 (ISUP grade 4–5)
BCR after radiation therapy	
Low-risk BCR	IBF > 18 mo and bGS <8 (ISUP grade <4)
High-risk BCR	IBF ≤ 18 mo or bGS 8–10 (ISUP grade 4–5)

cal recurrence; PSA-DT = prostate-specific antigen pGS = pathological Gleason score; ISUP = International ogical Pathology; IBF = interval from primary therapy to ure; bGS = biopsy Gleason score.



cMo miM1

[De novo (synchronous) vs. metachronous]

Not to be confused with:

Oligo-progressive M1a/b: <3 non-visceral mets.

PSMA in omPC

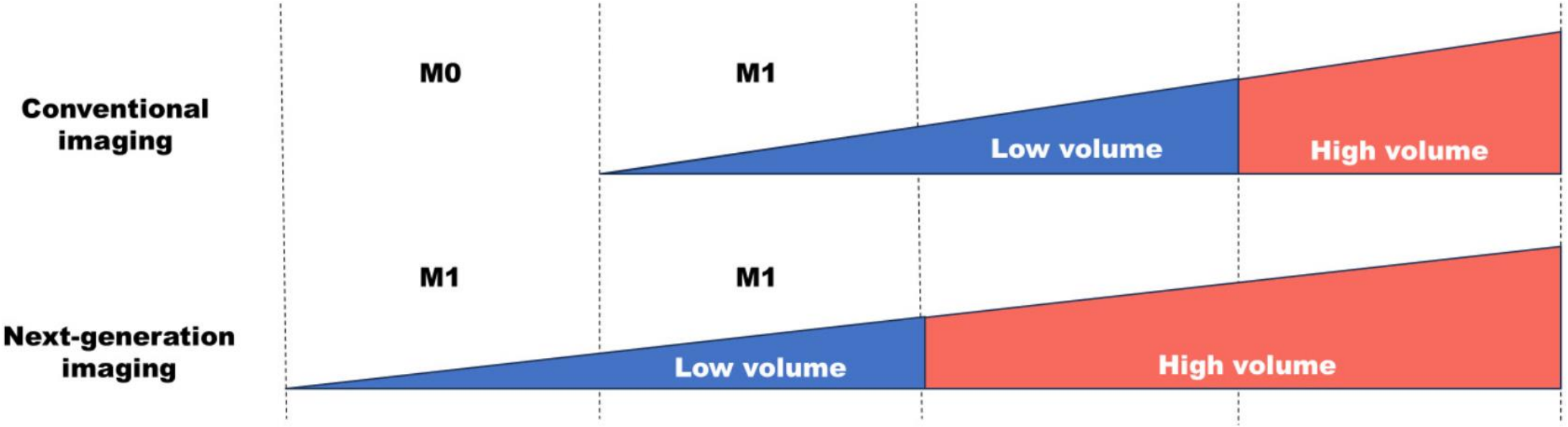
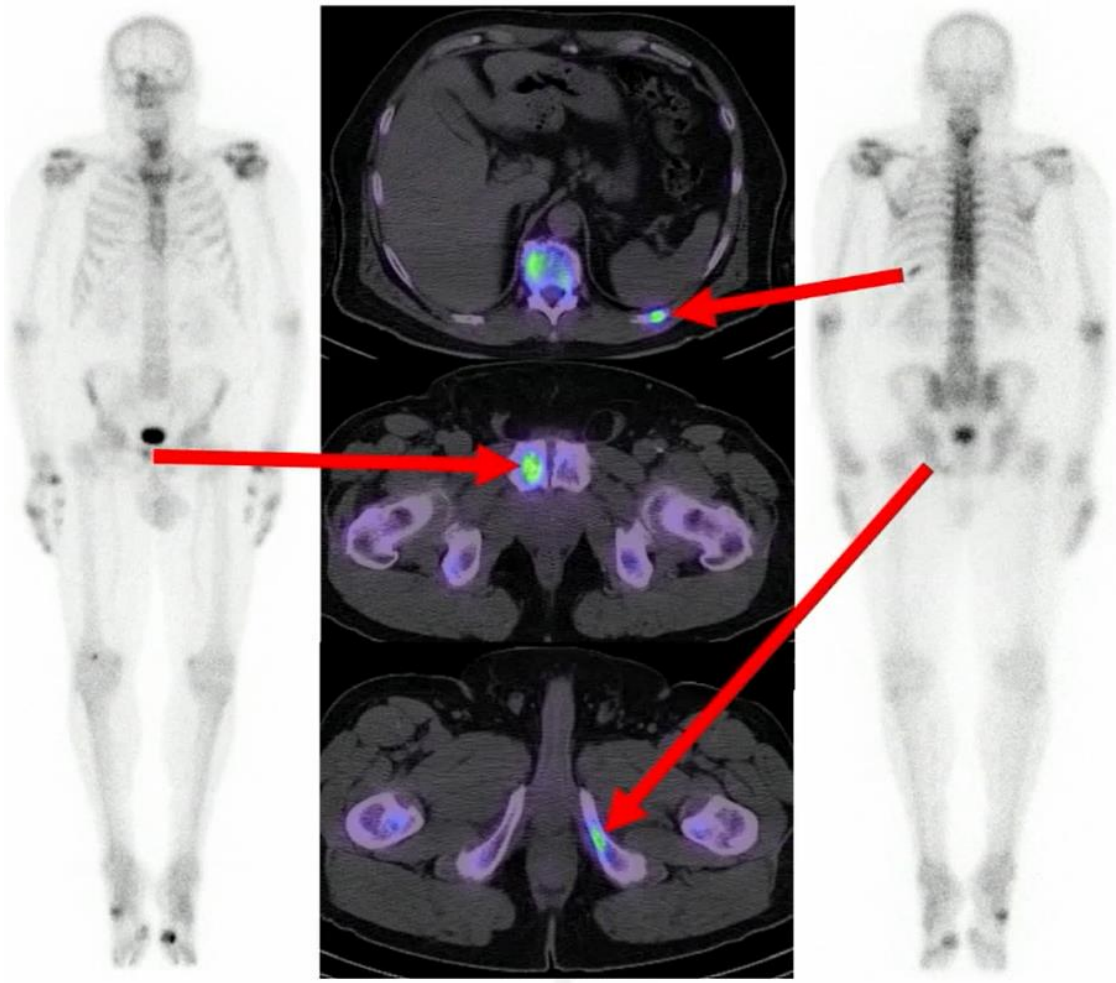


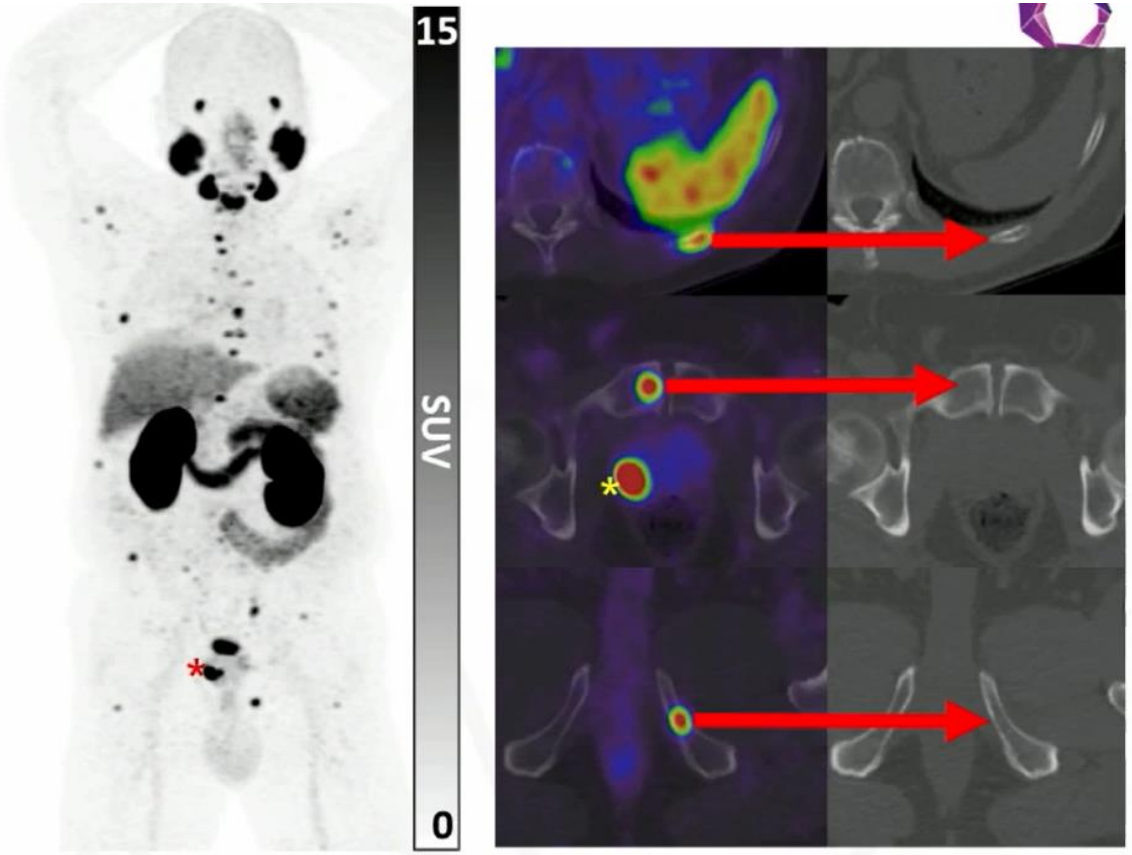
Figure 1. Stage migration owing to next-generation imaging.

✓High- vs. low-volume: 40 cc (10)

How much to intensify?



BS + SPECT/CT: low burden

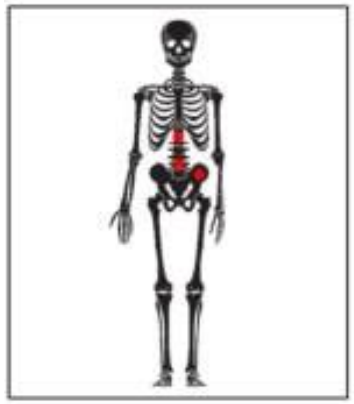


(CHAARTED: ≥4 bone metastases, ≥1 outside vertebral bodies or pelvis, or visceral metastases[1])

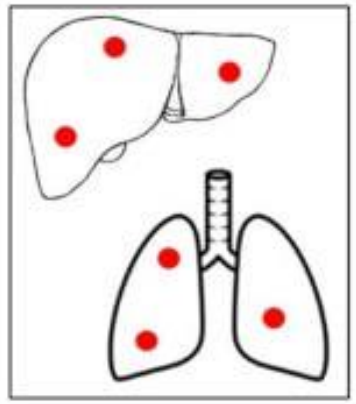
PSMA PET: high burden

Hofman, APCCC 2022

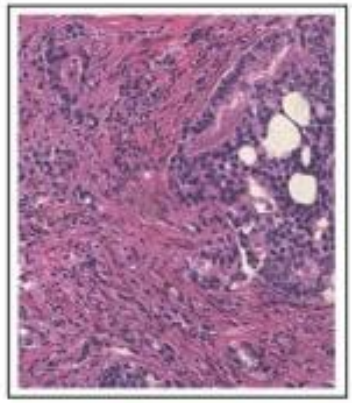
Definition of **High-Risk** disease according to LATITUDE study
(At least two of the following criteria)



3 or more bone mets



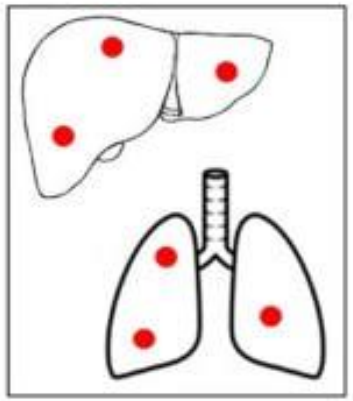
Visceral mets



Gleason score ≥ 8

Definition of **High-Volume** disease according to CHAARTED study
(At least one of the following criteria)

4 or more bone mets
(with at least one outside the pelvis/column)



Visceral mets

Oligo M1

[definitions:

<3-5 mets in conventional imaging

2-3 mets in PSMA PET/CT]

Opposite to these definitions (on conventional imaging):

High-risk M1: 2 of 3 (≥3 M1b, M1c, GG 4-5)

High-volume M1: (≥4 M1b AND ≥1 extra-axial) OR M1c

TABLE 2
Characteristics of and Differences in ENRT Templates

Region	RTOG	PIVOTAL	NRG
Cranial border	L5/S1 interspace	Lower border of L5	Bifurcation of aorta or inferior caval vein (typically L4/L5)
Margin around vessels	7 mm (carving out bone, bowel, bladder)	7 mm (carving out bone, bladder, muscle, rectum, bowel + 3 mm)	5–7 mm (carving out bone, bladder, muscle, bowel), enlarge to 10 mm when indicated
Presacral nodes	S1–S3, 10 mm anterior to sacrum	S1–S3, 12 mm anterior to sacrum	Presacral, prevertebral and posterior perirectal nodes until S3
External iliac nodes	Until top of femoral heads	Until top of femoral heads	Until vessels are more lateral than the most medial aspect of the acetabulum (typically middle of femoral head)
Obturator nodes	Until top of pubic symphysis	Until 1 cm above top of symphysis	Until midportion of prostate bed (in definitive setting until seminal vesicles join the prostate)

Best coverage of LNs: NRG
1/3 of LNs were not covered conventionally (1/2 of the patients)

For more information, please message me via:

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