JSRS 2026

Rectal Cancer
Advances in Imaging & Treatment
future perspectives on clinical practice

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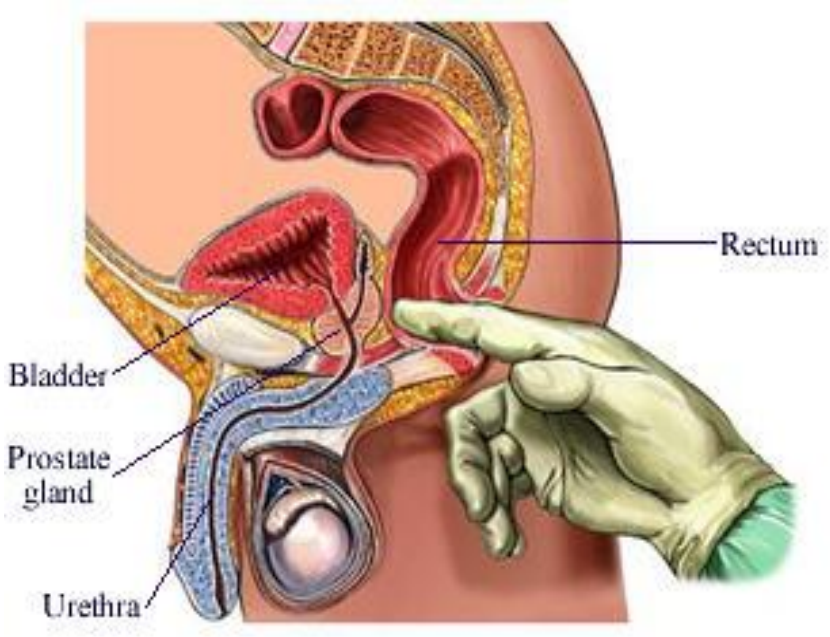
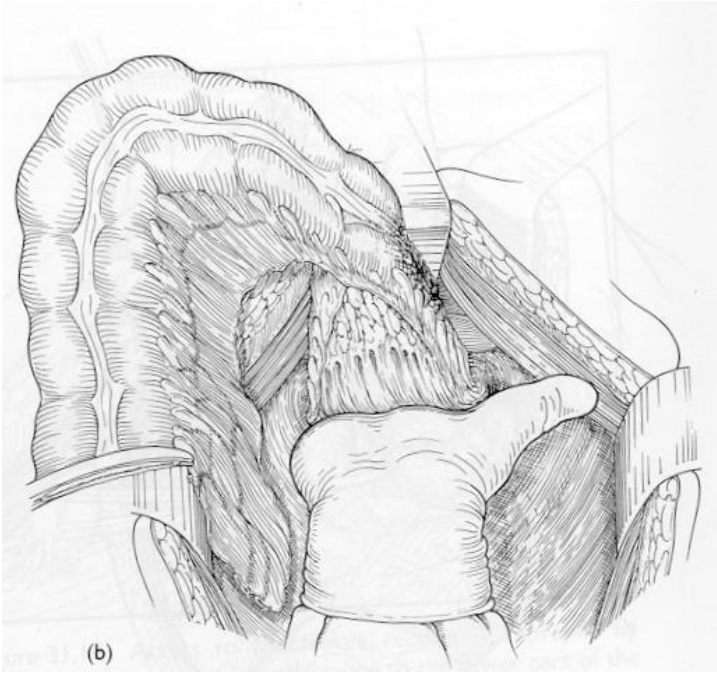
Maastricht University Maastro Maastricht Radiation Oncology Institute

History…





Staging: finger

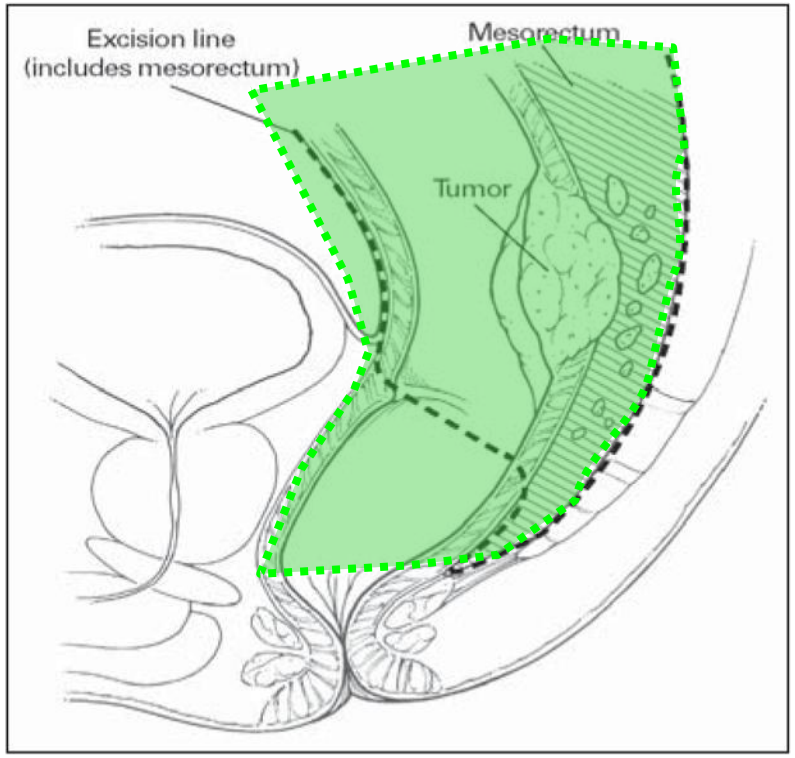
Surgery: hand

Local Recurrence 40% → ≤ 3%

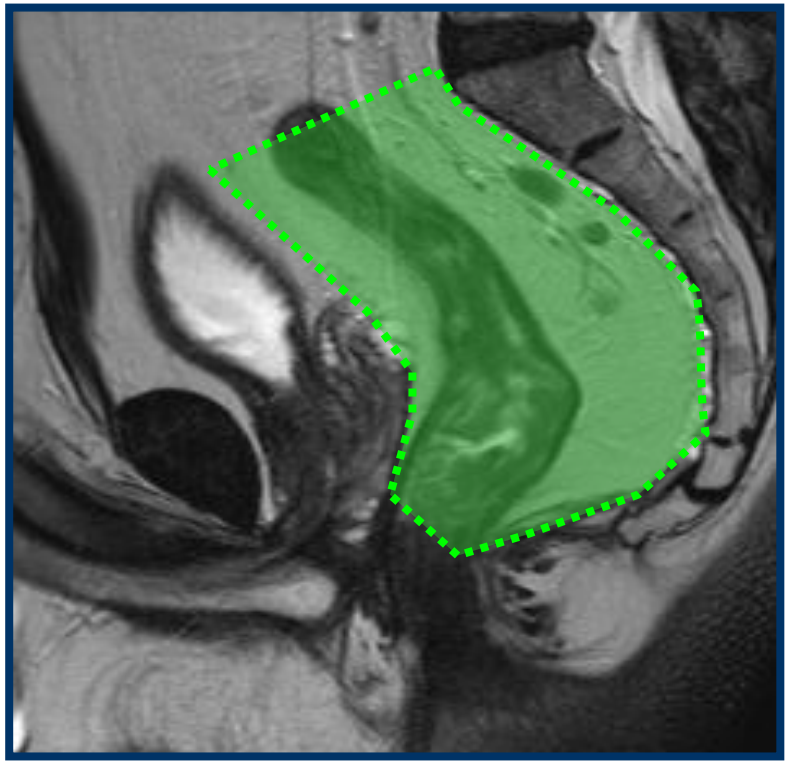
Major steps forward

- ✓ Total Mesorectal Excision
- ✓ Preoperative Chemoradiotherapy
- ✓ MR imaging

Total Mesorectal Excision

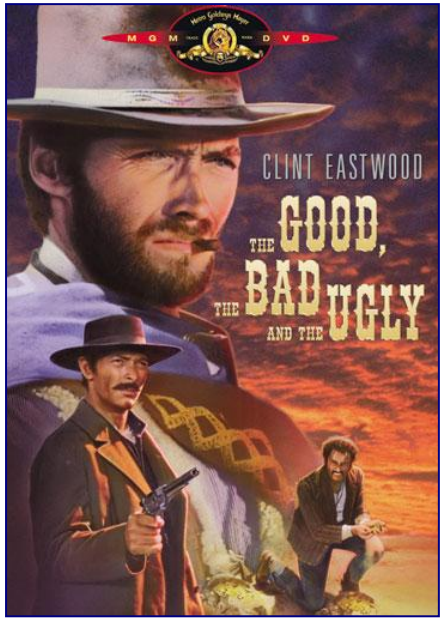


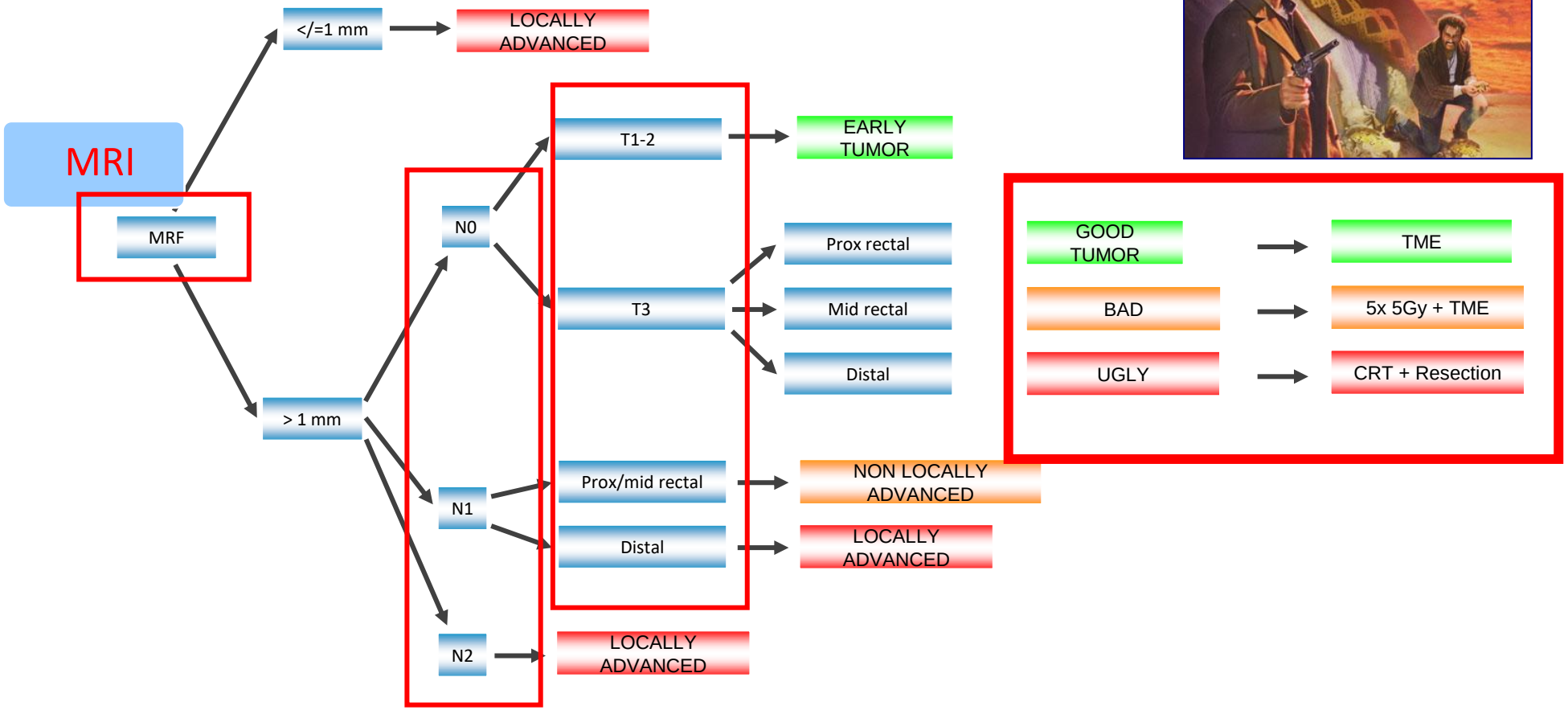
Heald et al. The Lancet 1986



Beets-Tan et al. The Lancet 2021

MR based stratification
n=296

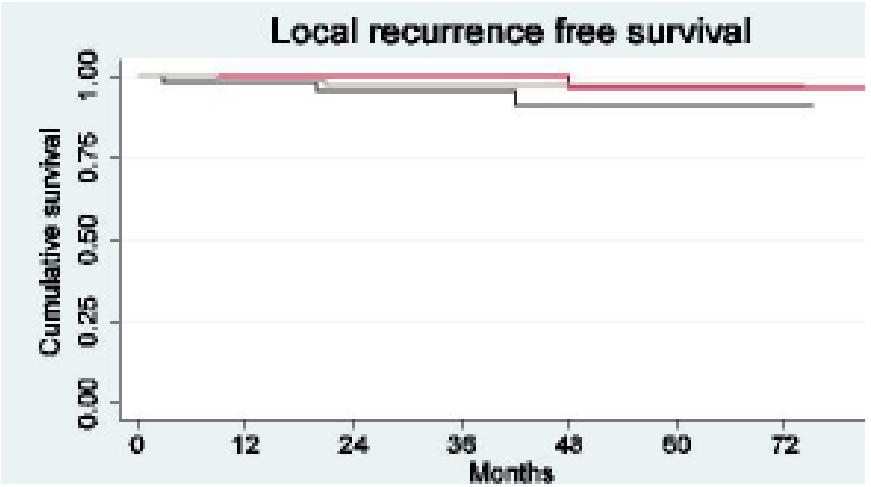


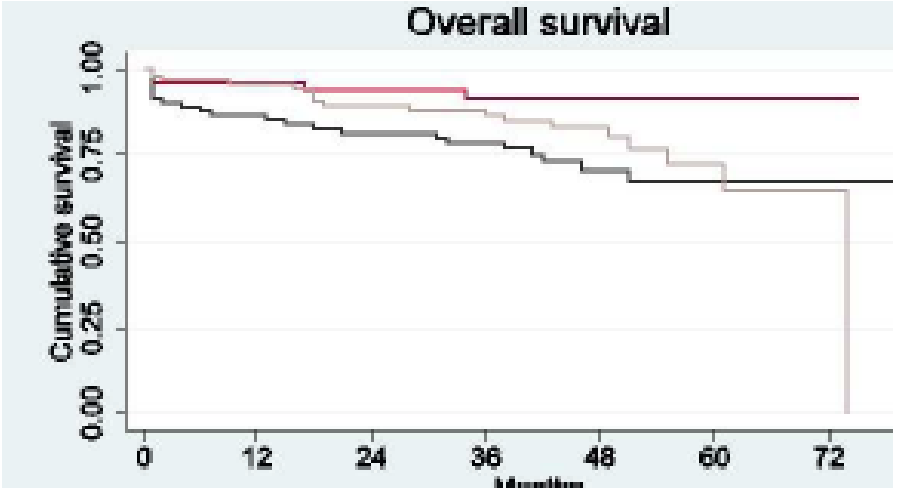


Engelen et al. Eur J Cancer 2013

Modern multidisciplinary treatment of rectal cancer based on staging with magnetic resonance imaging leads to excellent local control, but distant control remains a challenge

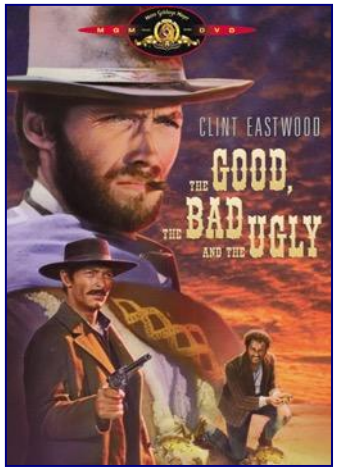
S.M.E. Engelen [a,b,1], M. Maas [a,b,1], M.J. Lahaye [b], J.W.A. Leijtens [c], C.L.H. van Berlo [d], R.L.H. Jansen [e], S.O. Breukink [a], C.H.C. Dejong [a], C.J.H. van de Velde [f], R.G.H. Beets-Tan [b], G.L. Beets [a,*]



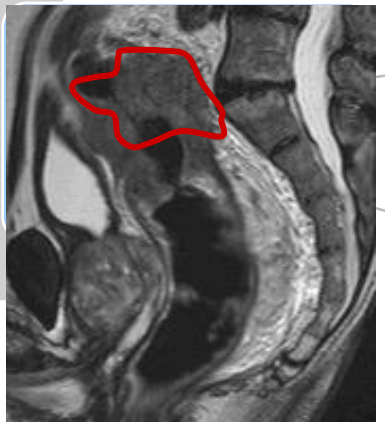


Engelen et al. Eur J Cancer 2013

Differentiated treatment



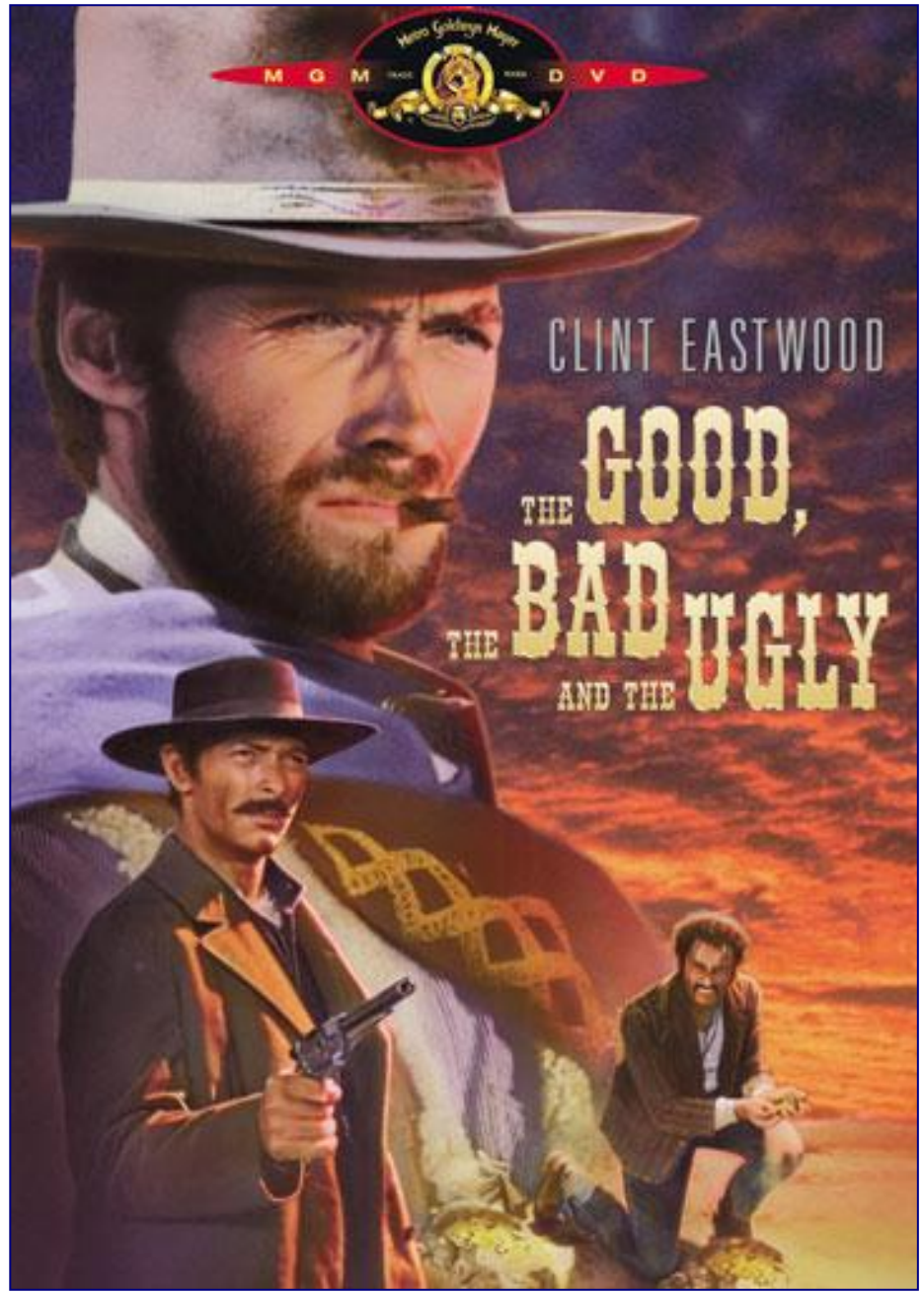
Rectal cancer



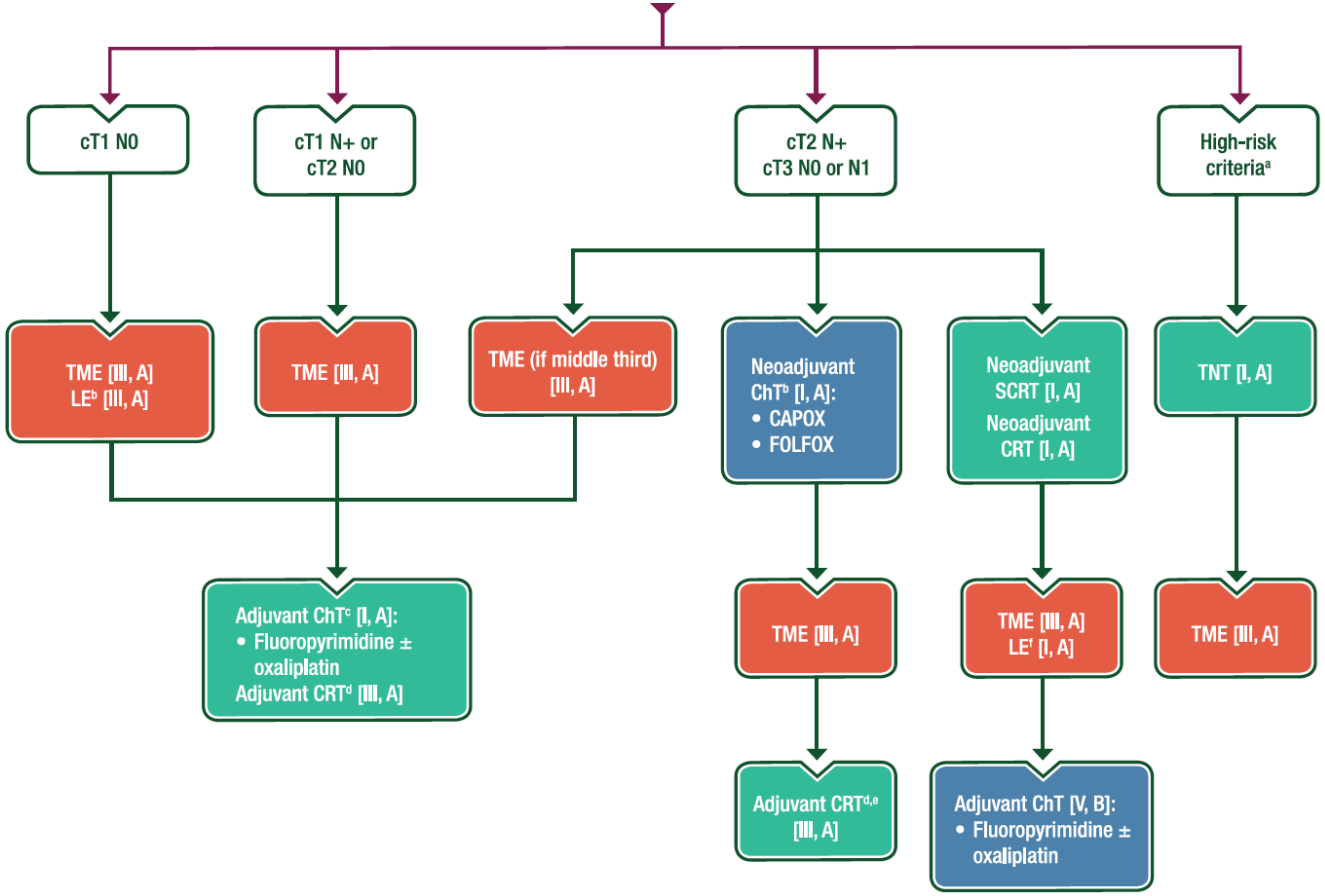
- Local excision
- TME
- CRT
  - Resection
- RT/CRT
  - chemo
  - Resection

2001

- **Paradigm Shift in Treatment:**
  from adjuvant to neoadjuvant
- **Radiology has become more predictive**
- **MRI identifies risk groups**



Surgery intended



ESMO

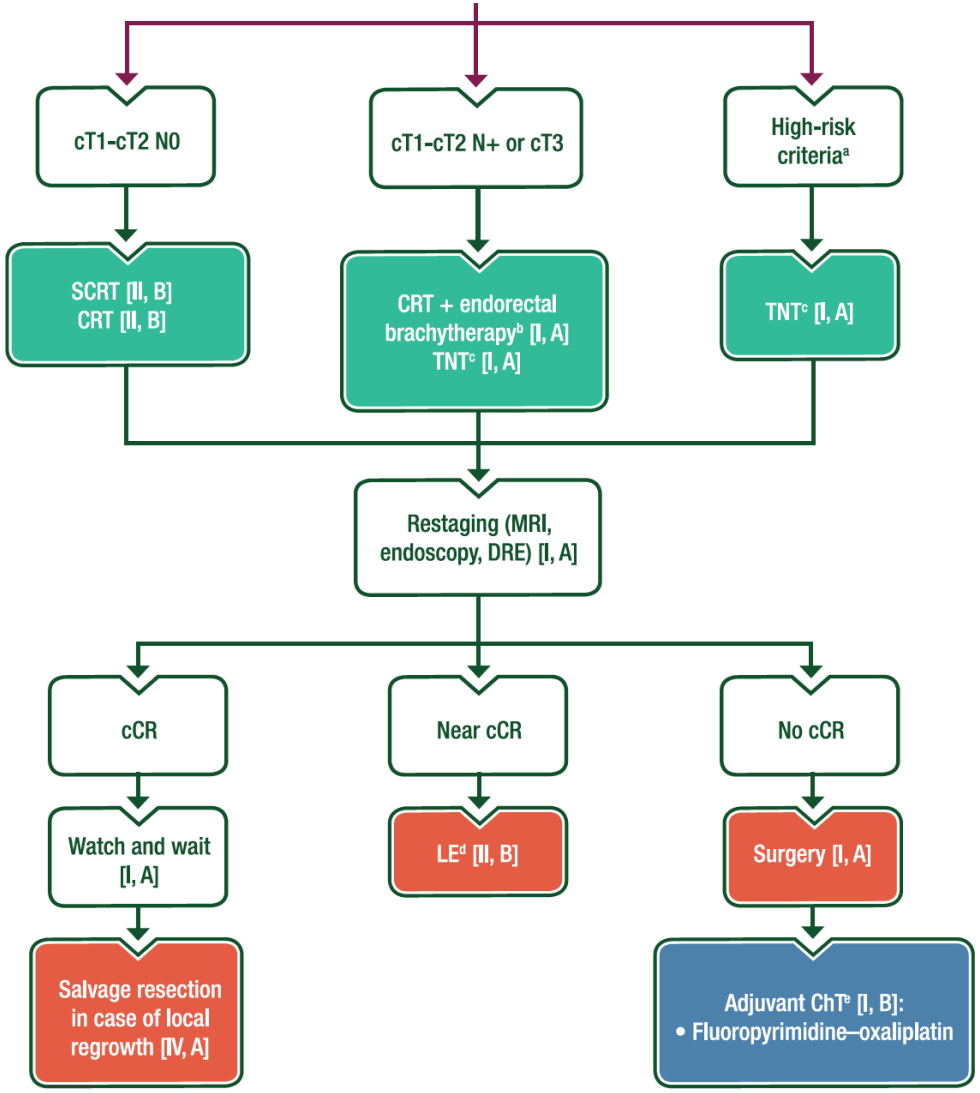
ANNALS OF ONCOLOGY

SPECIAL ARTICLE

Localised rectal cancer: ESMO Clinical Practice Guideline for diagnosis, treatment and follow-up☆

R.-D. Hofheinz[1], E. Fokas[2], L. Benhaim[3], T. J. Price[4], D. Arnold[5], R. Beets-Tan[6], M. G. Guren[7], G. A. P. Hospers[8], S. Lonardi[9], I. D. Nagtegaal[10], R. O. Perez[11], A. Cervantes[12,13] & E. Martinelli[14], on behalf of the ESMO Guidelines Committee*

Organ Preservation intended



Updated ESGAR guidelines
therapy driven - risk adapted approach

ESGAR Rectal Imaging Guideline Group *European Radiology*
https://doi.org/10.1007/s00330-025-12274-w

EUROPEAN SOCIETY OF RADIOLOGY
European Radiology

GASTROINTESTINAL Open Access

MRI to guide clinical management of rectal cancer: updated consensus recommendations from the European Society of Gastrointestinal and Abdominal Radiology (ESGAR)—PART I primary staging

ESGAR Rectal Imaging Guideline Group*

ESGAR Rectal Imaging Guideline Group *European Radiology*
https://doi.org/10.1007/s00330-025-12275-9

EUROPEAN SOCIETY OF RADIOLOGY
European Radiology

GASTROINTESTINAL Open Access

MRI to guide clinical management of rectal cancer: updated consensus recommendations from the European Society of Gastrointestinal and Abdominal Radiology (ESGAR): PART II—Restaging and response evaluation

ESGAR Rectal Imaging Guideline Group*

ESMO guidelines

high risk:

cT4a, cT4b

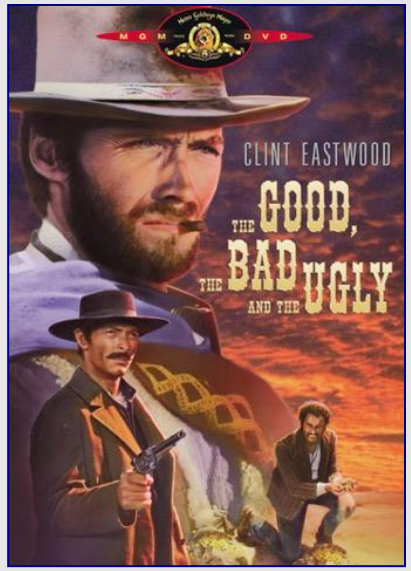
MRF+

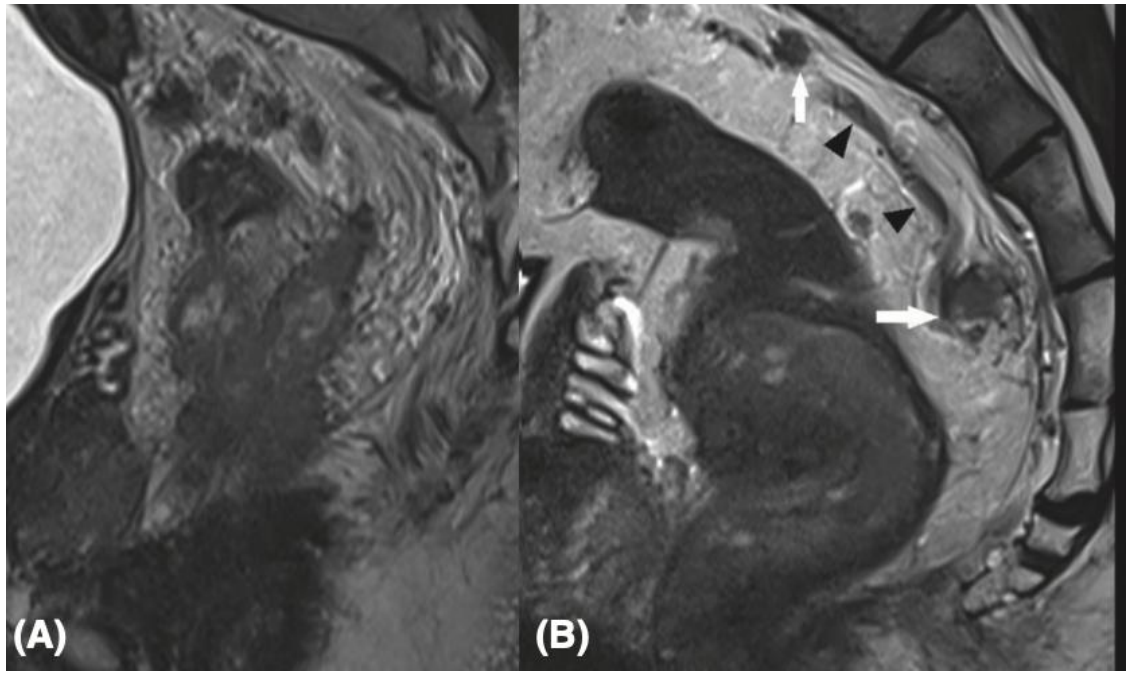
EMVI+

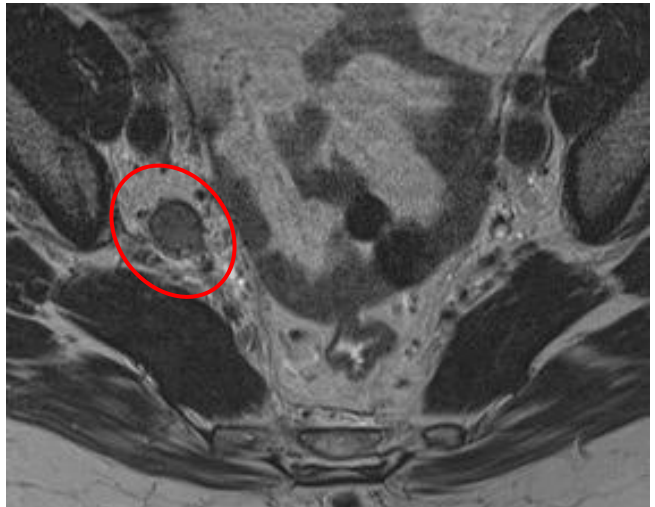
Tumor Deposits

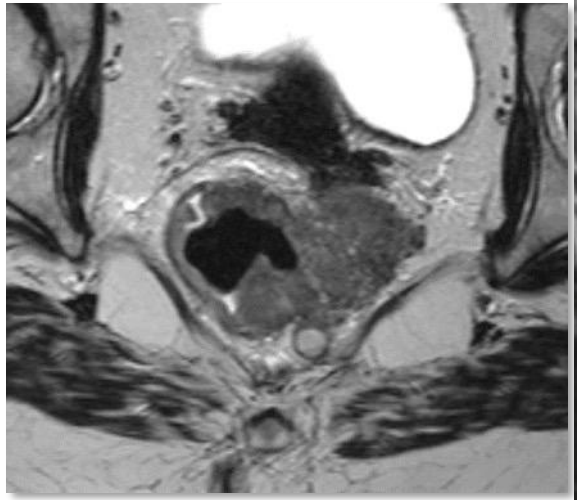
cN2

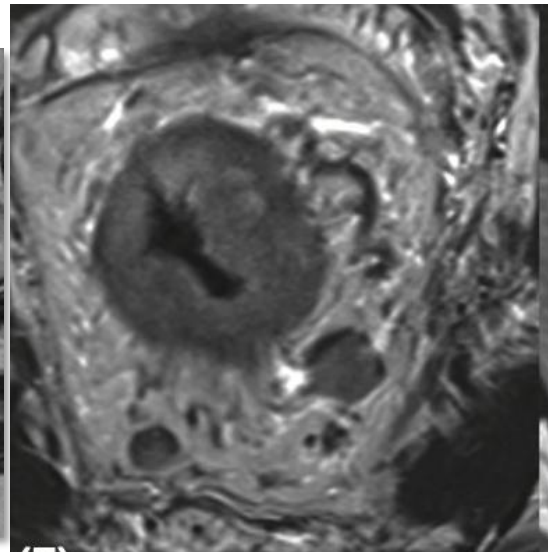
Lateral nodes >= 7mm

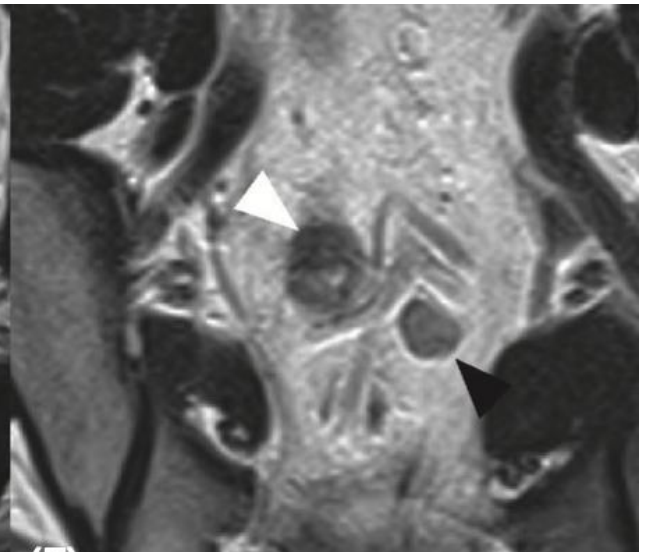




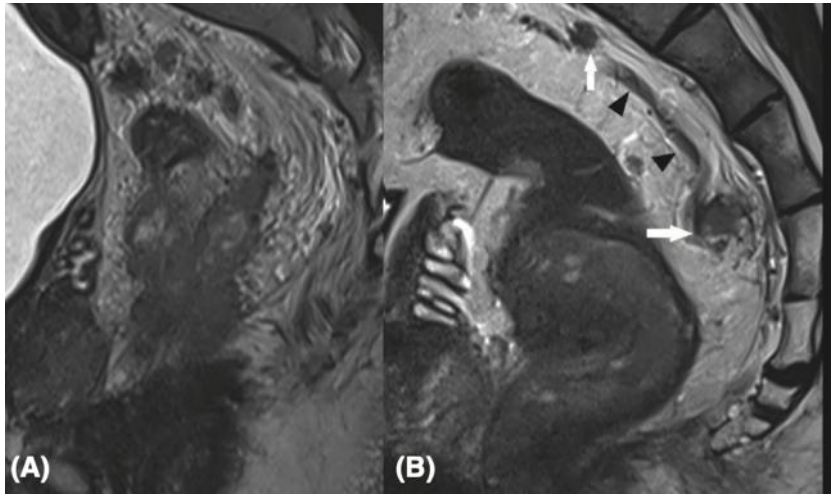








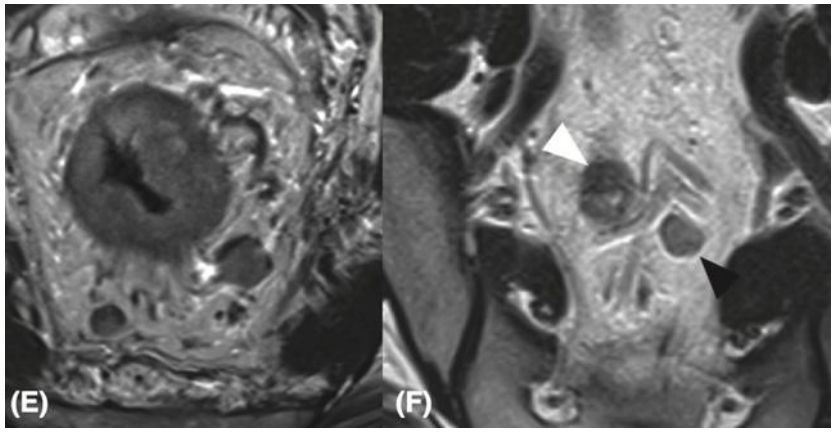
MR risk features do not correlate well with histology….



Multirater agreement between 4 experts

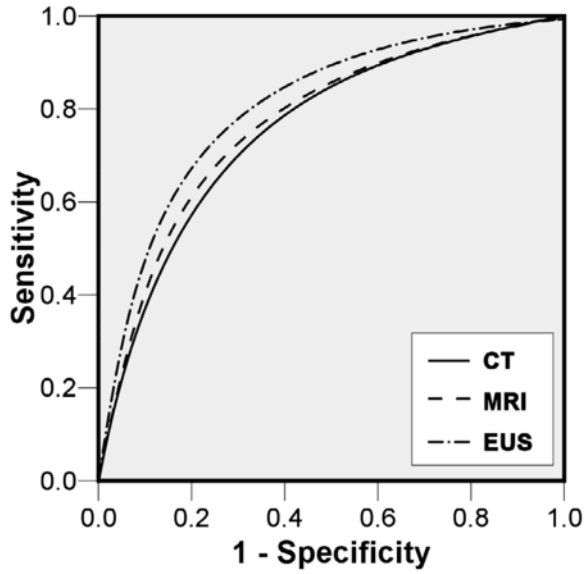
EMVI	$k = 0.45$
TD	$k = 0.35$
LN	$k = 0.38$

Chandramohan et al. Colorectal Dis 2022



Lymphnode or Tumor Deposit?

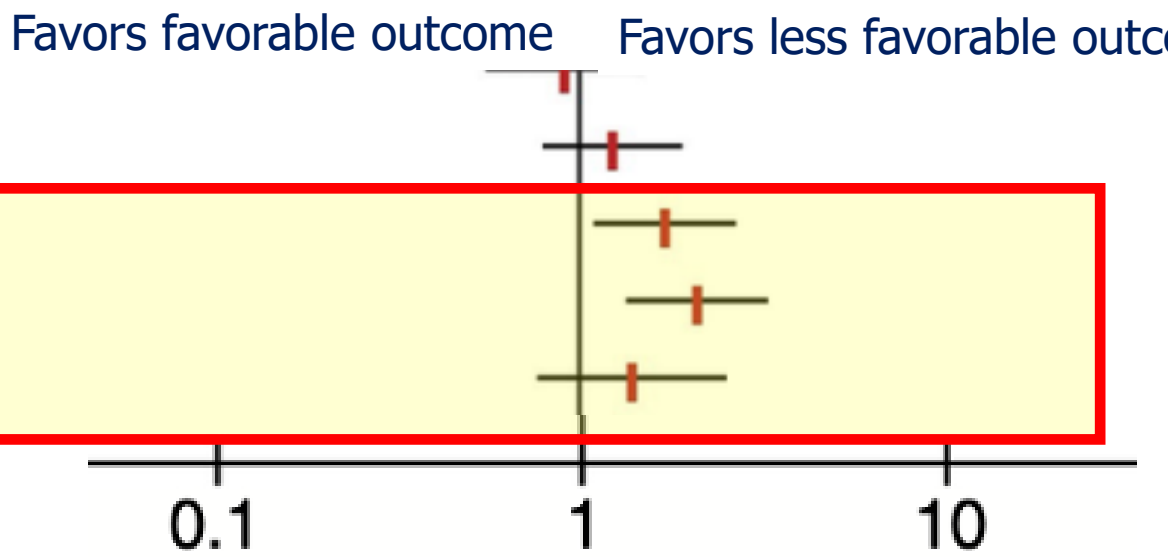
CRC nodal staging

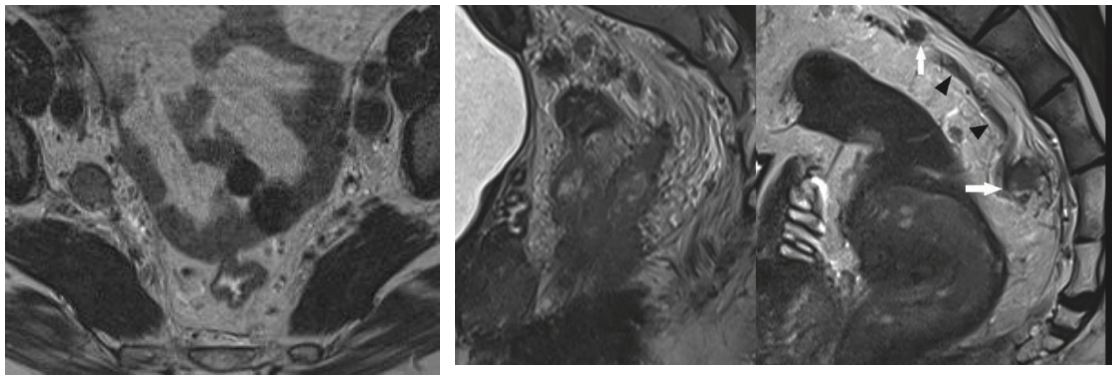


Lahaye et al. Meta analysis Seminar US,CT,MR

mrEMVI+, TD, Lateral LN+ have strongest association with less favorable 5yr DFS

Variables	Hazard ratio 95% CI
Pre-mrCRM	0.90 [0.51, 1.58]
Pre-mr-N	1.27 [0.77, 2.09]
Pre-mrEMVI	1.85 [1.11, 3.08]
Pre-mrTD	2.33 [1.40, 3.88]
Pre-mrPSW disease	1.46 [0.74, 2.88]

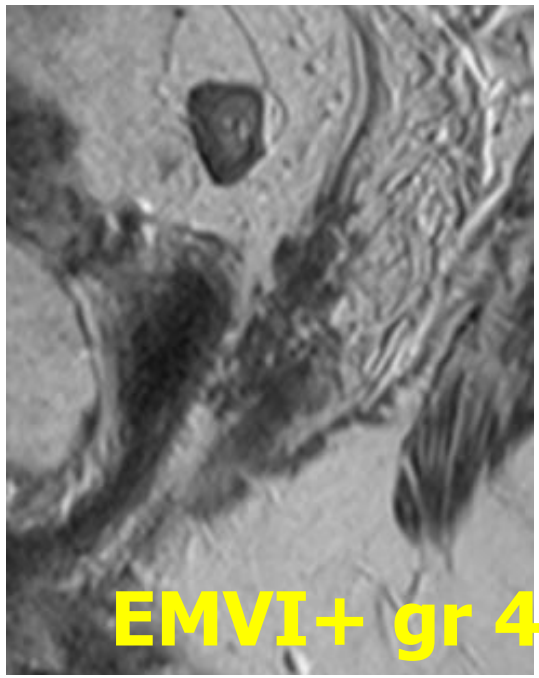


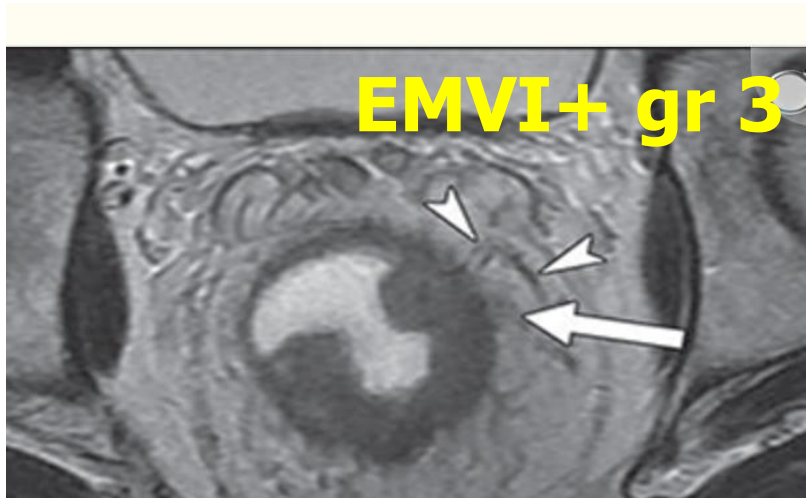


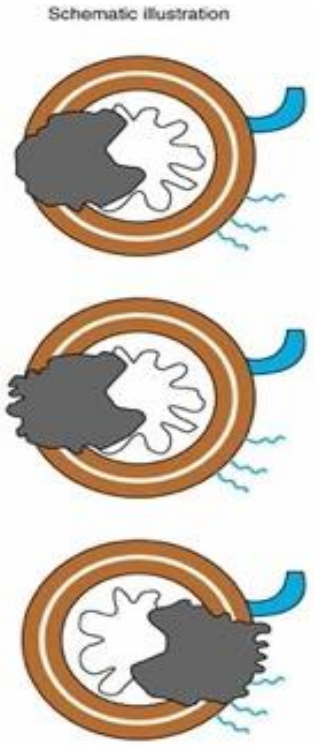
Chandramohan et al. Colorectal Dis 2022

MR for EMVI+
meta-analysis

Pooled sensitivity 0.60
pooled specificity 0.90

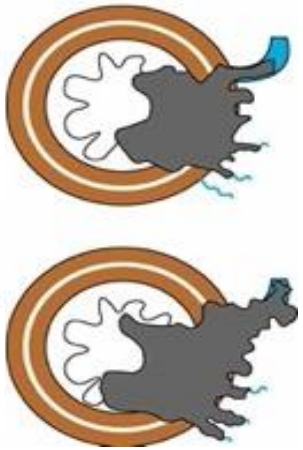






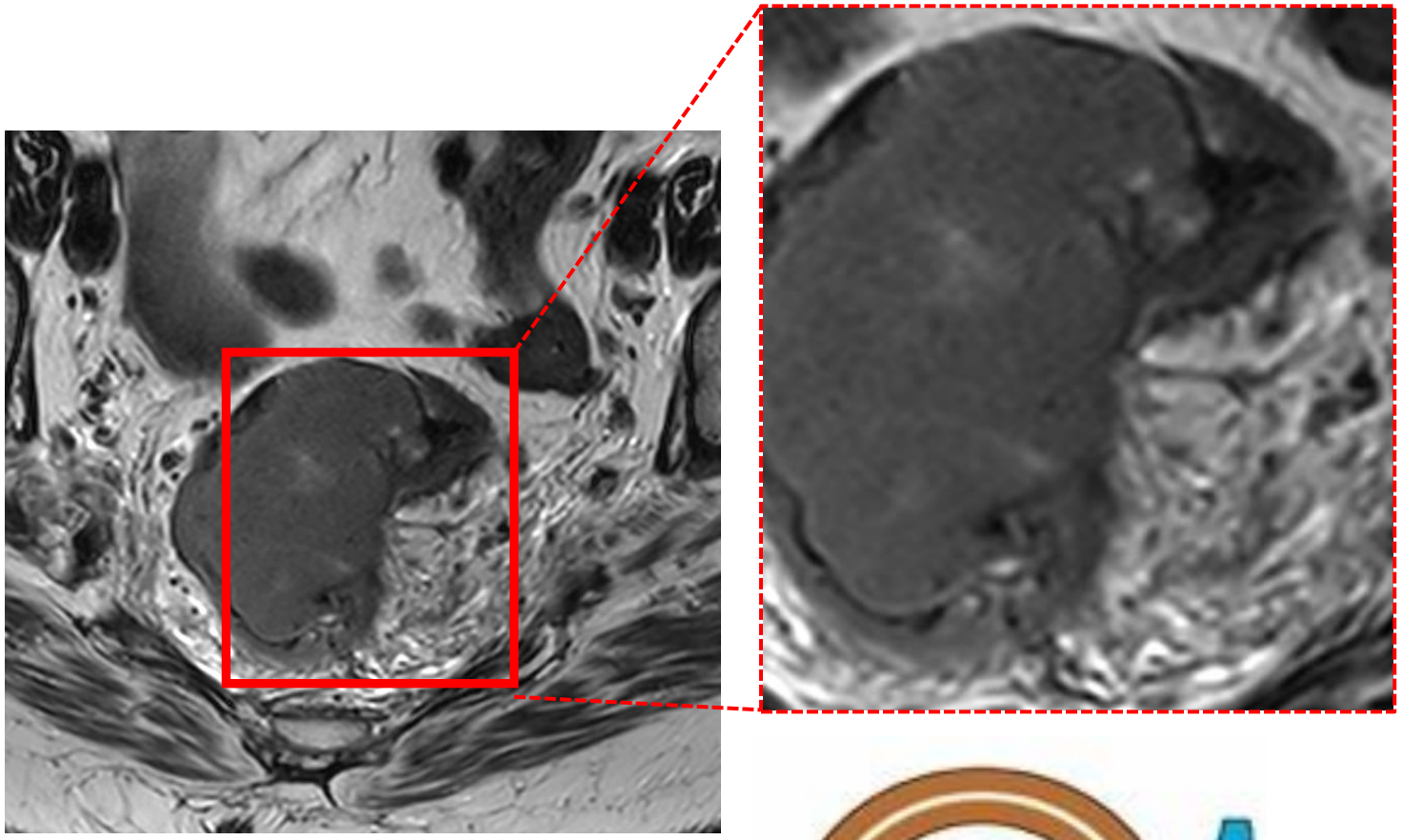
EMVI+ gr 3

EMVI+ gr 4



Inoue et al. Insights Into Imaging 2021; Kim et al. AJR 2019

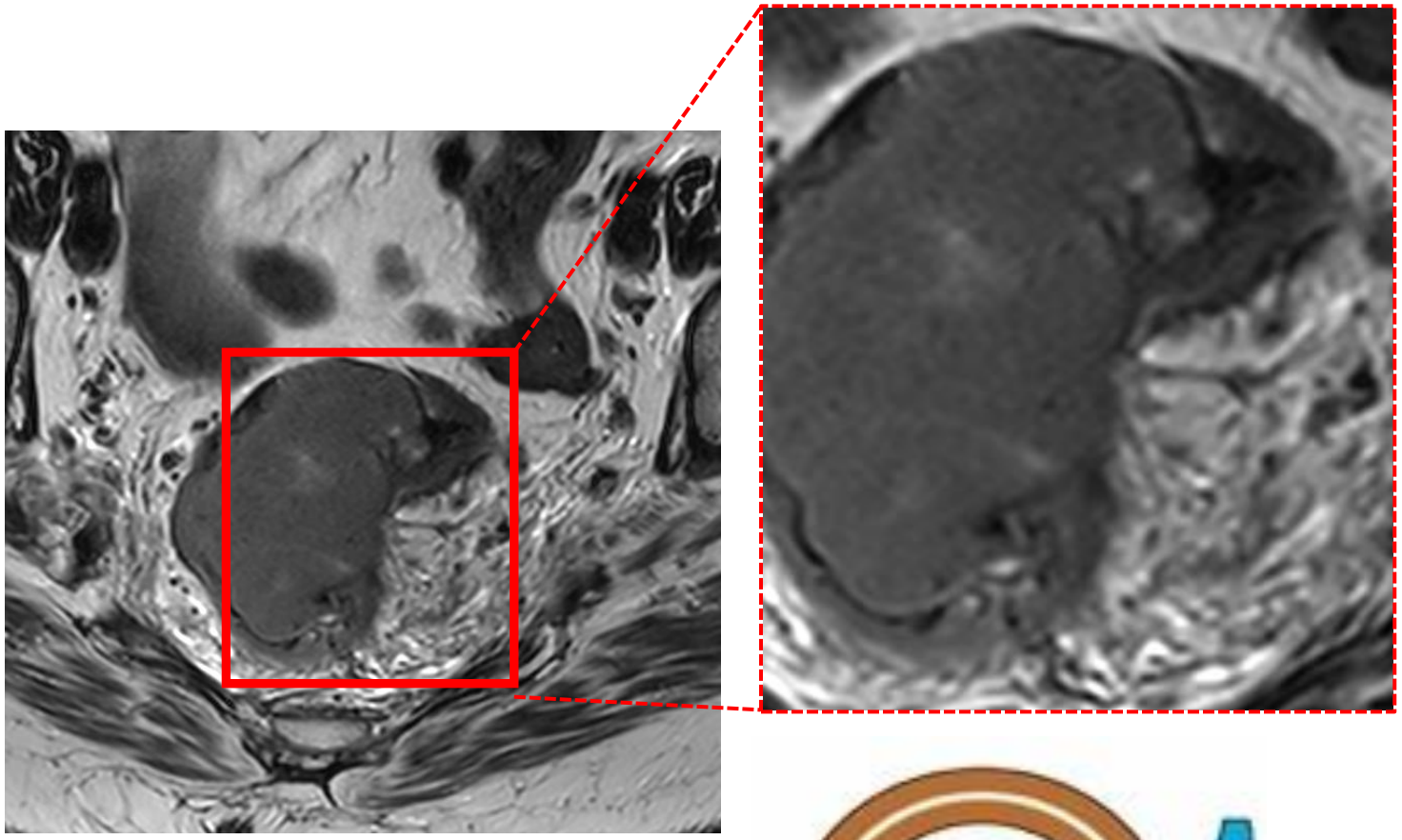
Difficulties in mr EMVI interpretation



EMVI grade 2

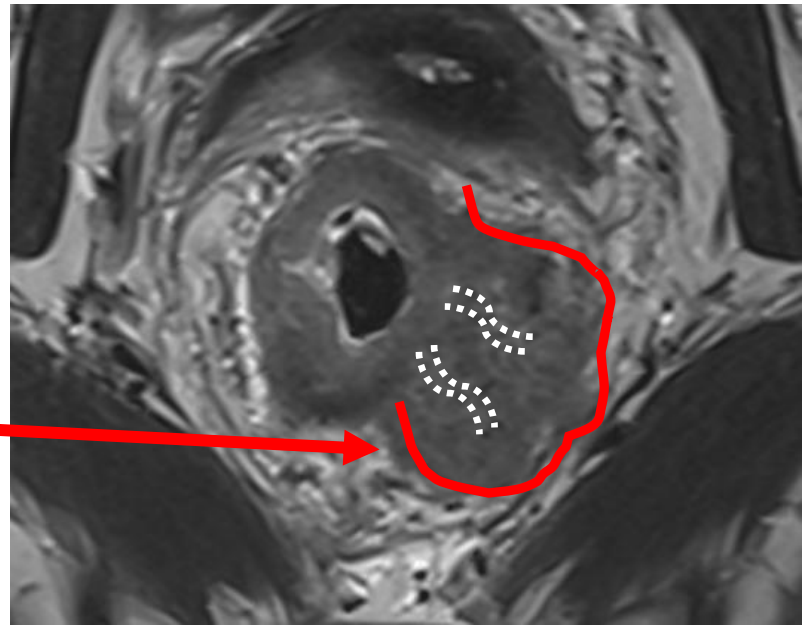
Courtesy Monique Maas

Difficulties in mr EMVI interpretation



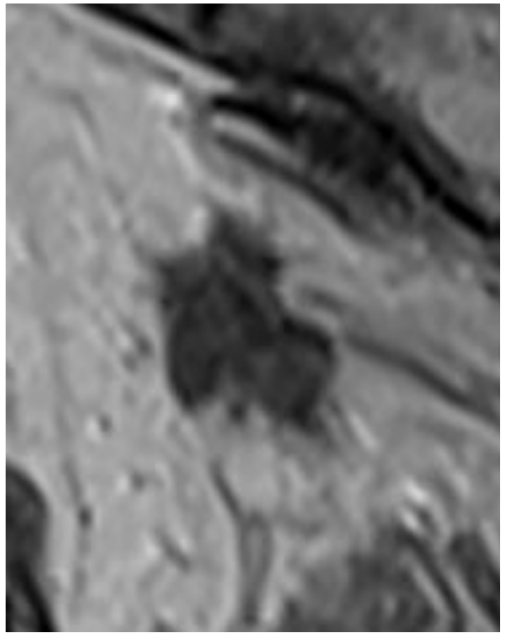
EMVI grade 2

Bulky tumor
EMVI pos (gr 4)



Courtesy Monique Maas

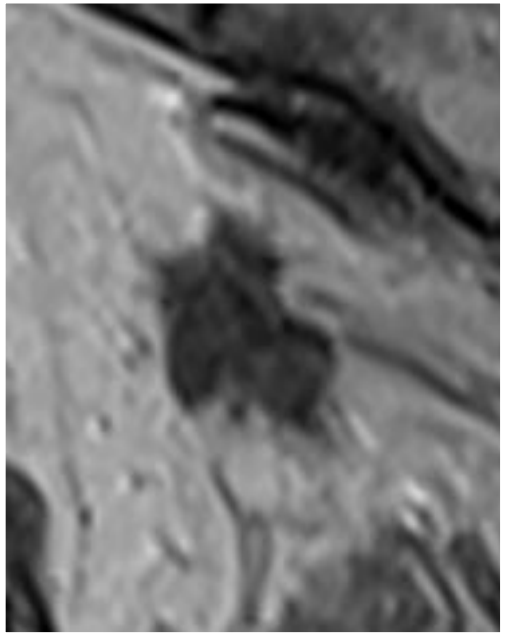
Tumor Deposits

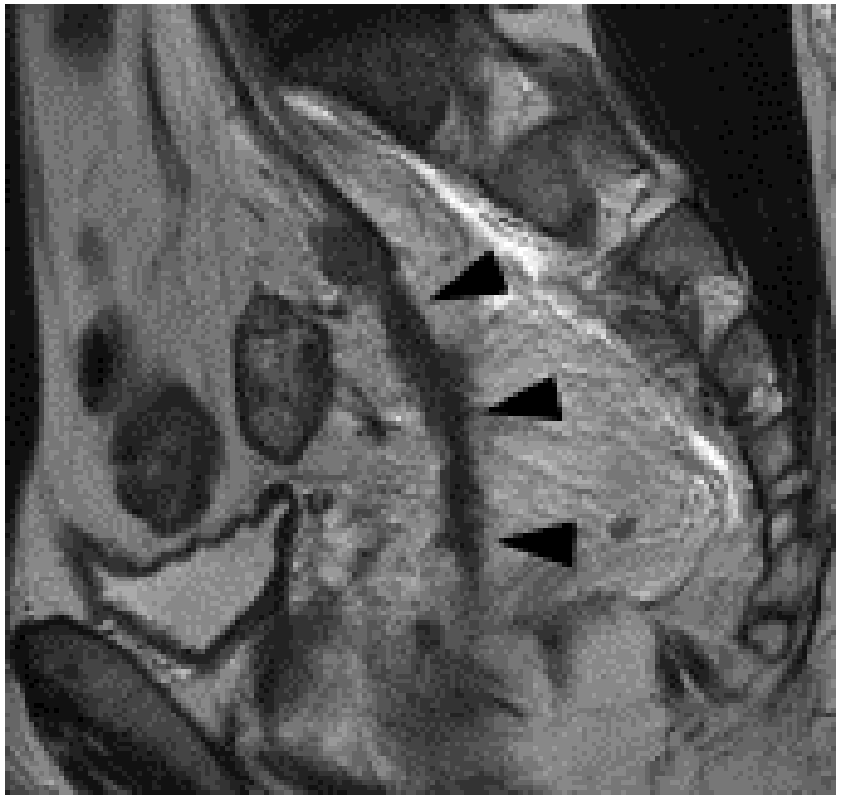


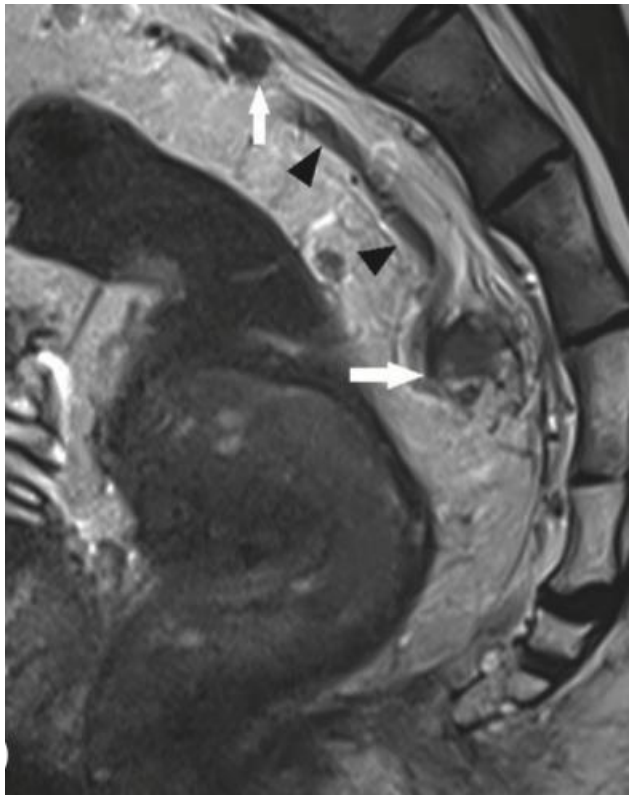
?

Tumor Deposits

discontinuous tumor foci in the lymph drainage region



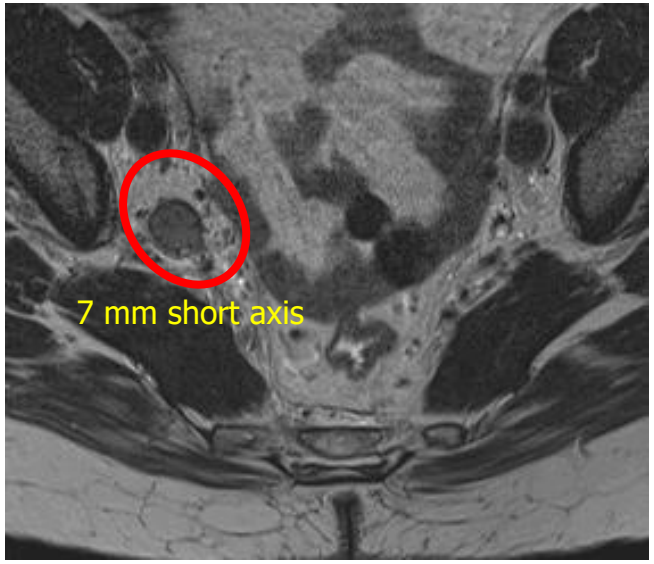


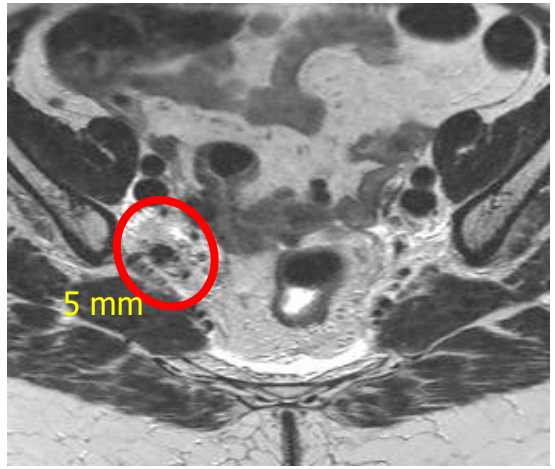


- Report TD status separate from N status
- If TD & N0 → final stage is N1c

Lateral Lymphnodes are regional nodes

obturator/internal iliac compartment





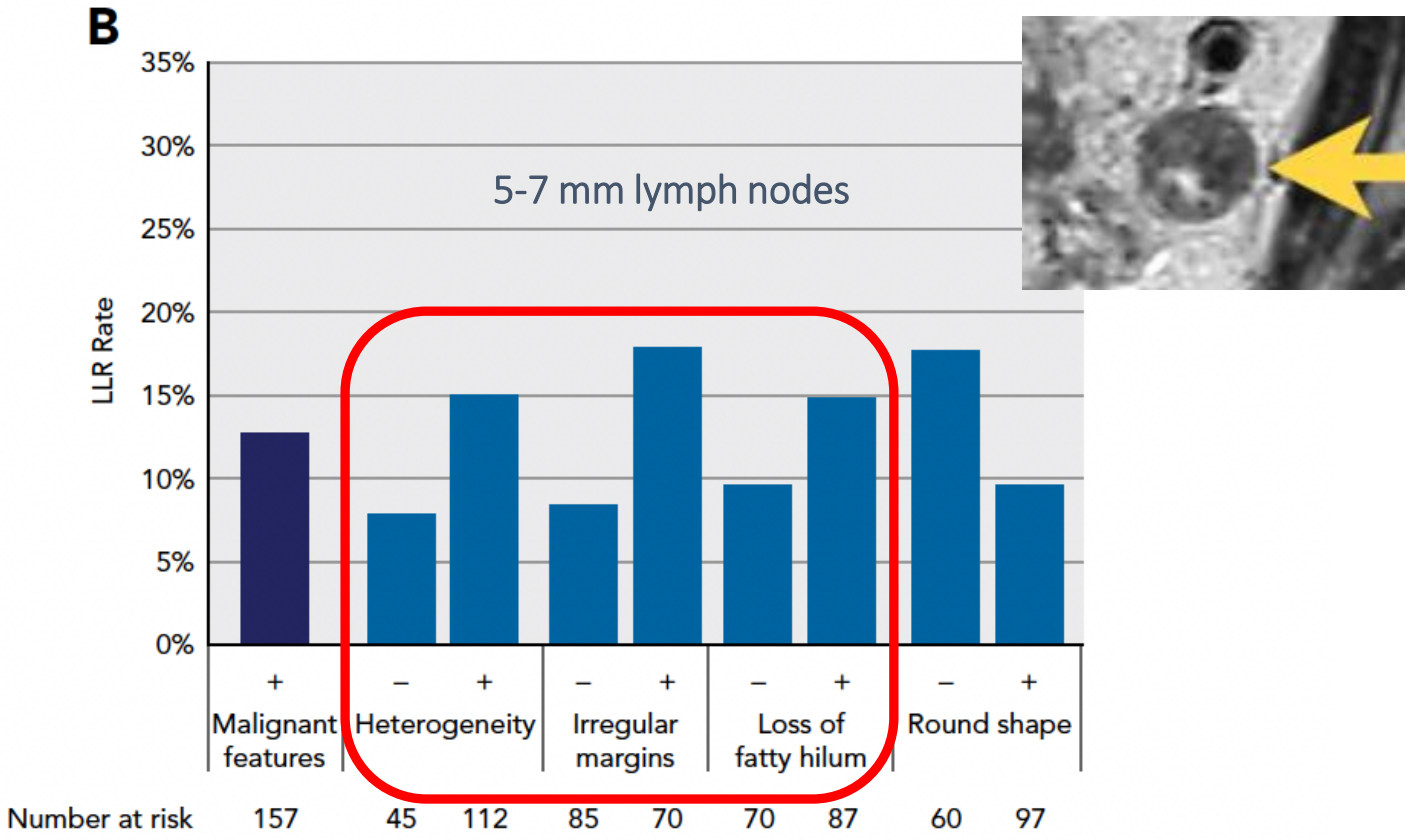
MRI LLN - short axis ≥ 7mm

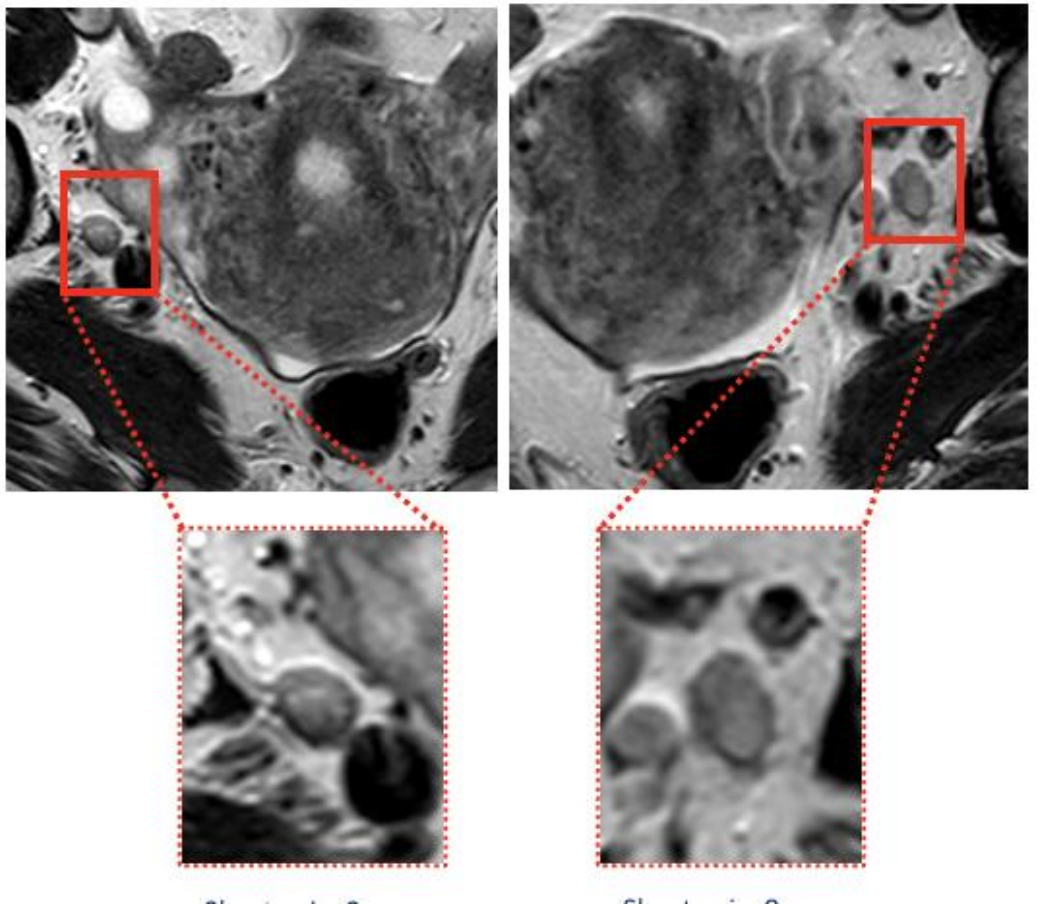
Without lateral node dissection → 5yr Lateral Local Recurrence 52%

With lateral node dissection → 5yr Lateral Local recurrence 9%

Ogura et al, JCO 2019
Ogura et al, JAMA surg 2019

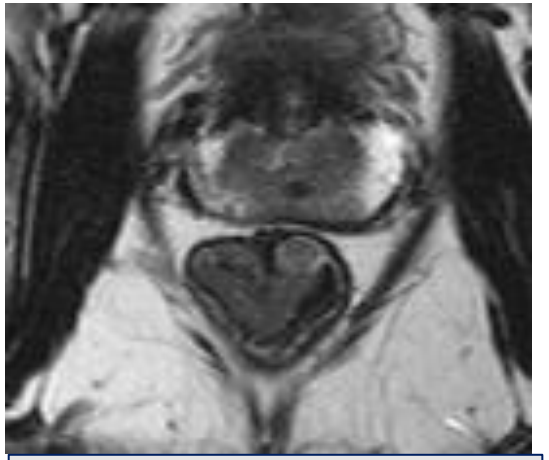
multiple LLNs ≥7.0 mm, heterogenous/irregular margins/loss of fatty hilum features contribute to higher risk for LLR.



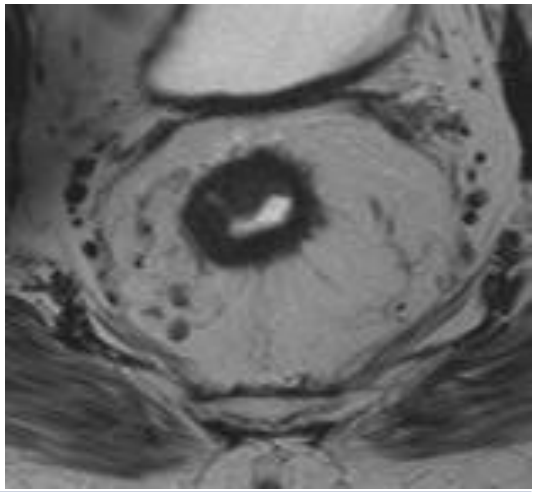


Kawai et al. ANZ J Surg 2022; van Geffen et al. EJSO 2024

Low-Intermediate risk tumors do well without preop RT



cT1-2



cT2-3ab

MRI feature	Good prognosis	Poor prognosis
CRM	>1mm clear	<1mm involved
Low rectal <5cm	intersphincteric plane clear of tumor	intersphincteric plane involved by tumor
T stage	T1/T2, T3a<1mm, T3b, 1-5mm extramural spread	T3c>5mm extramural spread, T4
EMVI	negative	positive
N stage	any	any

T2-3ab≤5mm , any N stage

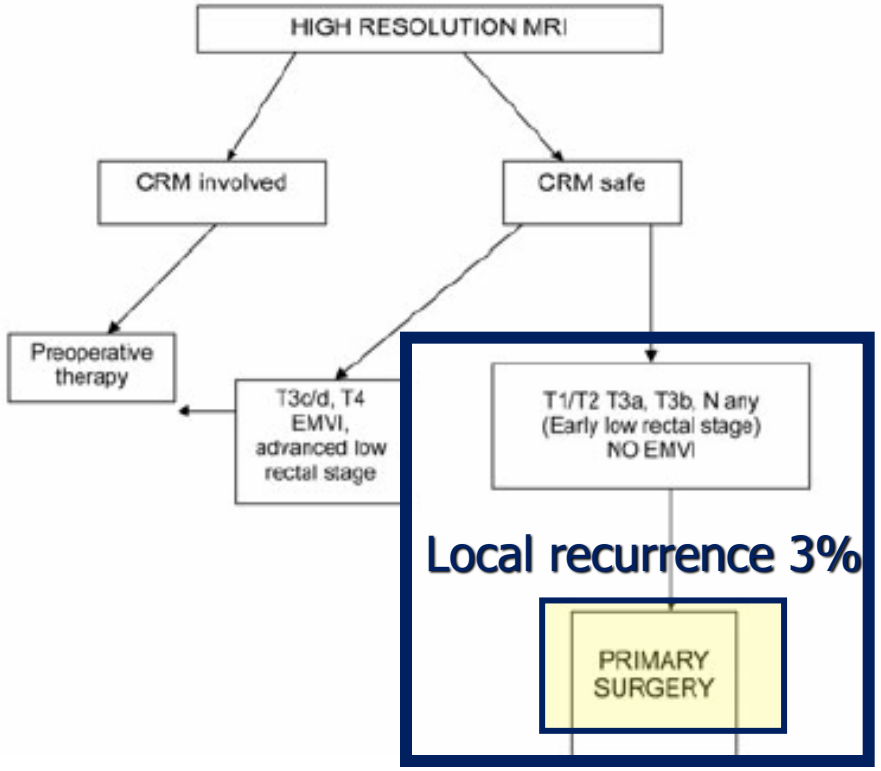
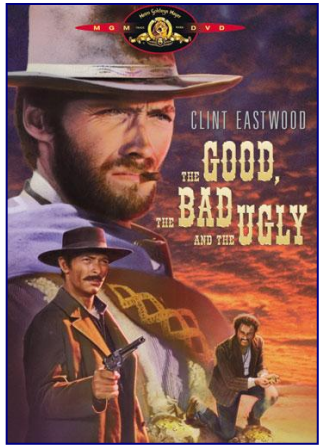
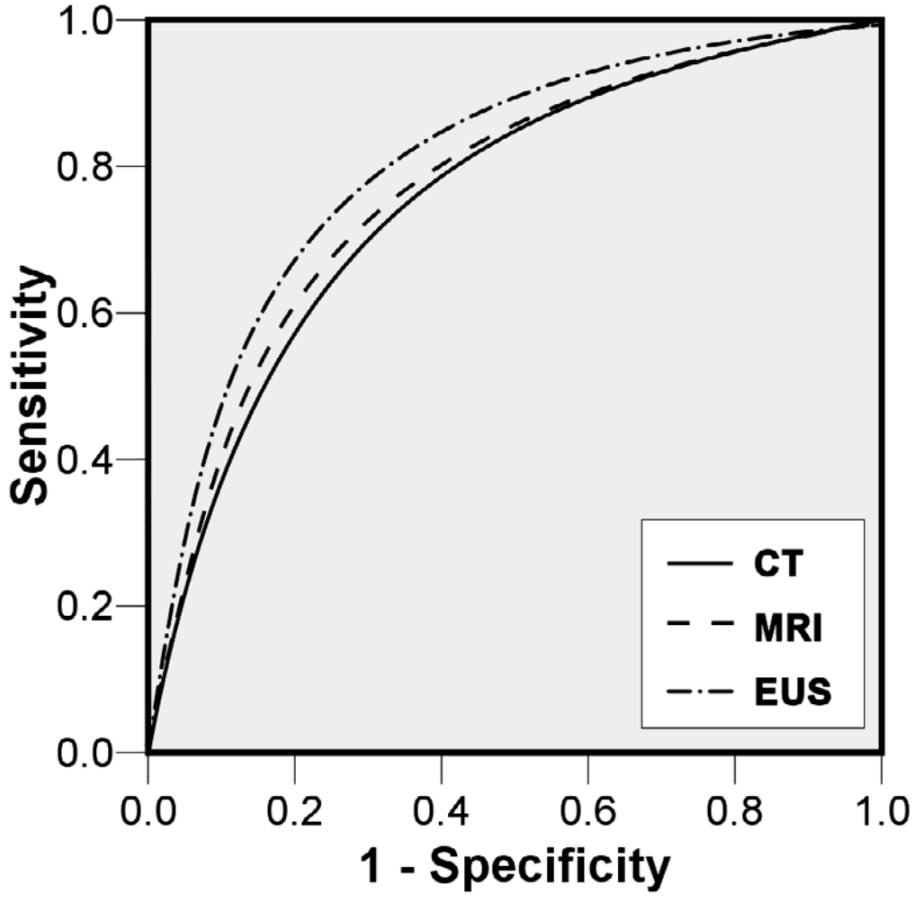


FIGURE 2. Treatment plans according to MRI prognosis.



Taylor et al. Annals of Surgery 2011

How to deal with nodes?

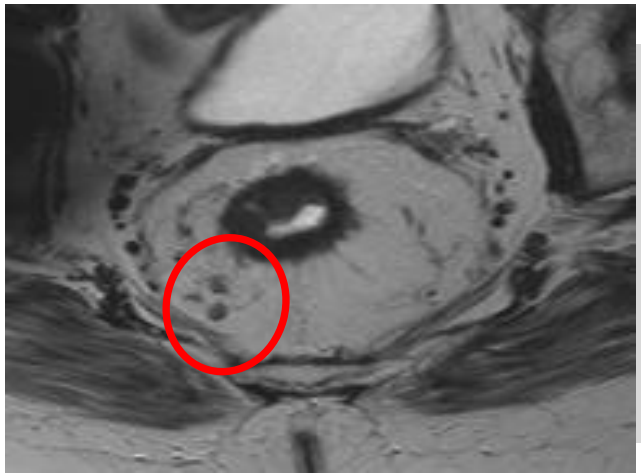


- > 50% of involved mesorectal nodes are < 5 mm
- **40% overstaging** if based on 5mm cut off

Lahaye et al. Meta analysis Seminar US,CT,MR 2005

ESGAR Guidelines Eur Rad 2018

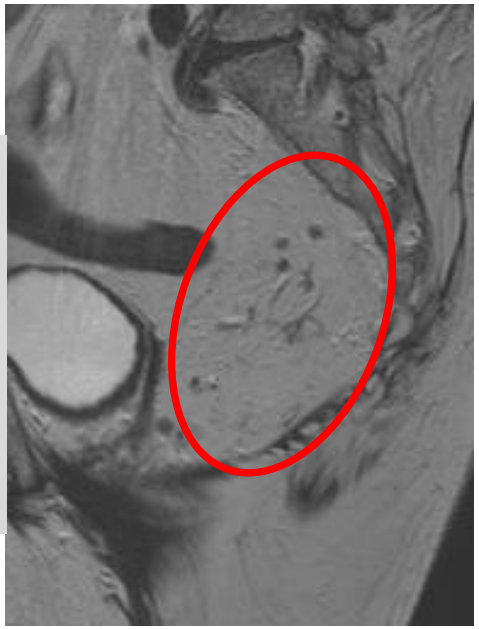
SAR guidelines Abd Radiology 2018



RISK ADAPTED NODAL STAGING

Overstaging

Down to 20%



Lymph nodes

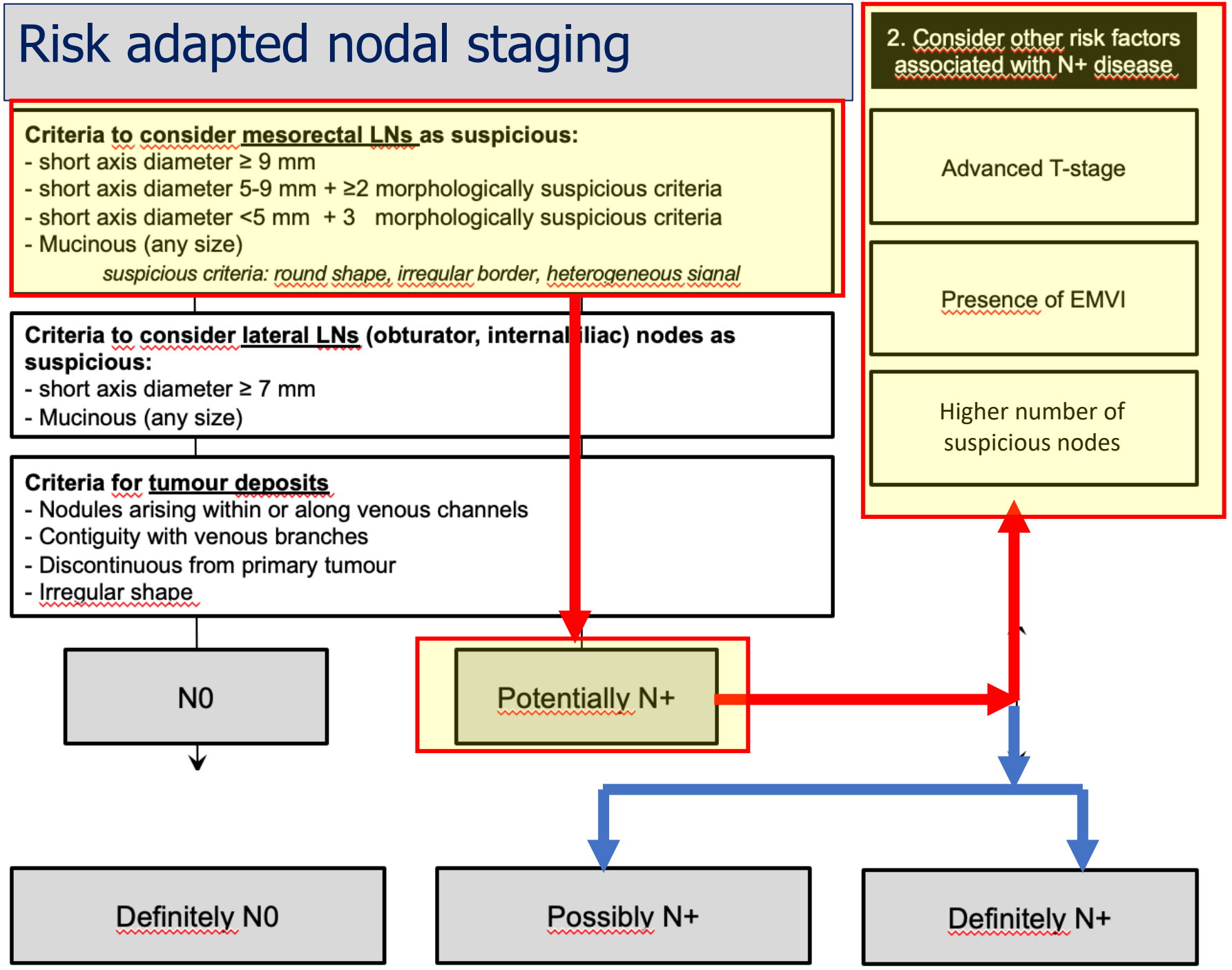
- ☐ cN0 (no visible [suspicious] nodes)
- ☐ cN+ (diameter >= 9 mm)
- ☐ cN+ (diameter 5-9 mm **AND at least 2 of the criteria**: round shape/ irregular border contour/ heterogeneous signal intensity)
- ☐ cN+ (diameter <5 mm **AND** round shape **AND** irregular border contour **AND** heterogeneous signal intensity)

Number of suspicious mesorectal lymph nodes: ……..

Number of suspicious extramesorectal lymph nodes: ……..

Updated Guidelines

Risk adapted nodal staging



Updated Guidelines

Structured MRI Reporting Template
- Primary Staging -

- ☐ cT1-2
- ☐ cT3ab (≤5 mm extramural growth)
- ☐ cT3cd (>5 mm extramural growth)
- ☐ cT4a (invading peritoneum or peritoneal reflection)
- ☐ cT4b, based on invasion of: ……
  (pelvic organs, pelvic floor/sidewall/external sphincter/other muscles, vessels, nerves, bone, anatomic compartment outside mesorectum, other large/small bowel loop)

- Extramural Vascular Invasion (EMVI): ☐ No ☐ Yes

- Sphincter invasion*: (indicate involved layer(s))
  ☐ No ☐ Intersphincteric space
  ☐ Internal sphincter ☐ External sphincter (=cT4b)

Lymph nodes and tumour deposits

- Suspicious mesorectal lymph nodes: …
  - size (short axis) ≥ 9 mm
  - size 5-9 mm AND ≥2 morphologic criteria*
  - size <5 mm AND 3 morphologic criteria*
  - mucinous

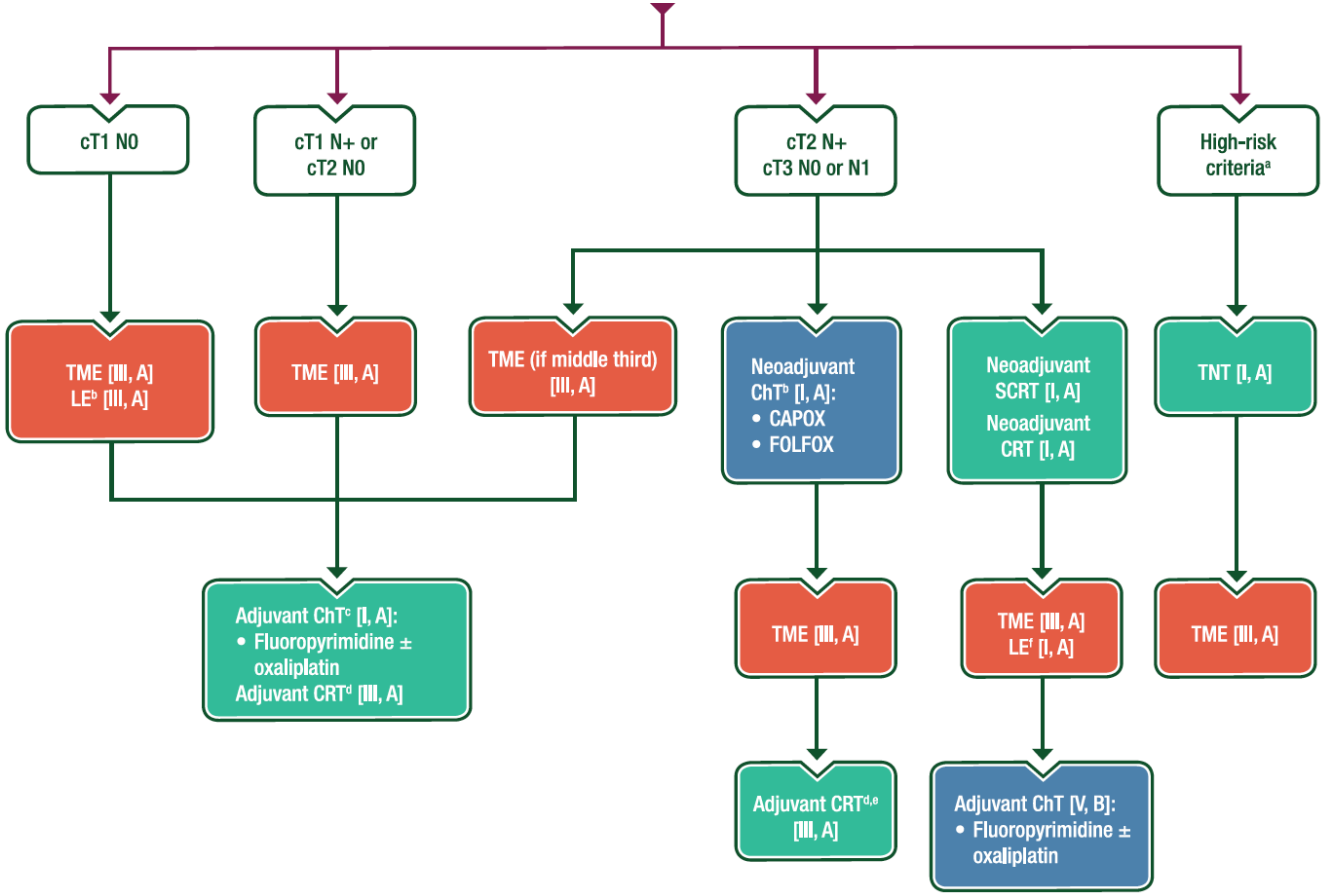
  ☐ No
  ☐ Yes: … (number, size)

- Suspicious regional lateral lymph nodes:
  - size ≥7 mm (or 5-7 mm with morphologic criteria*)
  - mucinous

  ☐ No
  ☐ Obturator: … (number, size, side)
  ☐ Internal iliac: …(number, size, side)

- Tumour deposits:
  ☐ No
  ☐ Yes: … (number, size)

Surgery intended



ESMO

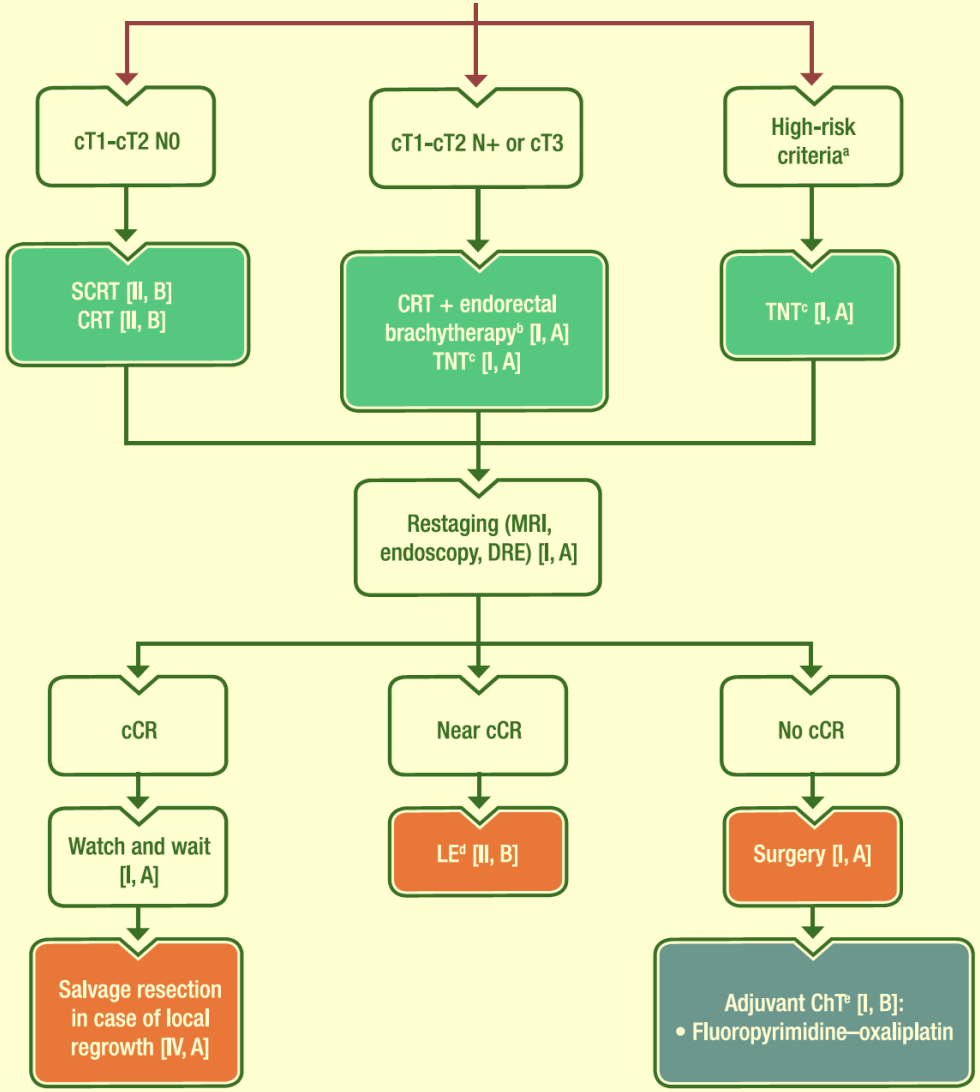
ANNALS OF ONCOLOGY

SPECIAL ARTICLE

Localised rectal cancer: ESMO Clinical Practice Guideline for diagnosis, treatment and follow-up☆

R.-D. Hofheinz[1], E. Fokas[2], L. Benhaim[3], T. J. Price[4], D. Arnold[5], R. Beets-Tan[6], M. G. Guren[7], G. A. P. Hospers[8], S. Lonardi[9], I. D. Nagtegaal[10], R. O. Perez[11], A. Cervantes[12,13] & E. Martinelli[14], on behalf of the ESMO Guidelines Committee*

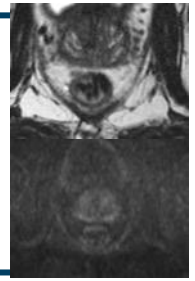
Organ Preservation intended



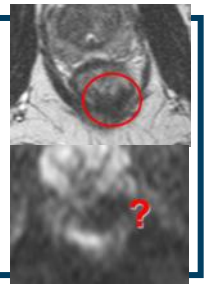
Sec Organ Preservation

Therapy-driven response evaluation

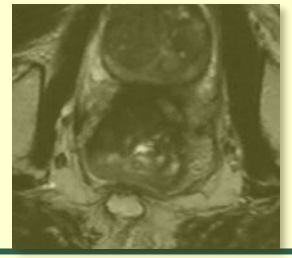
(near) cCR



Small residual tumour



obvious residual tumour



MRI detailed reporting

yN0

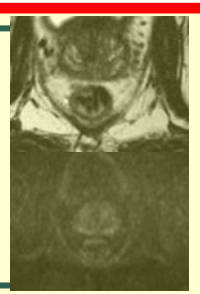
High risk features

POTENTIAL ORGAN PRESERVATION

Surgery

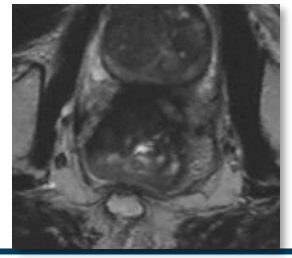
Organ Preservation

(near) cCR



Small residual tumour

obvious residual tumour



MRI detailed reporting

yN0

POTENTIAL ORGAN PRESERVATION

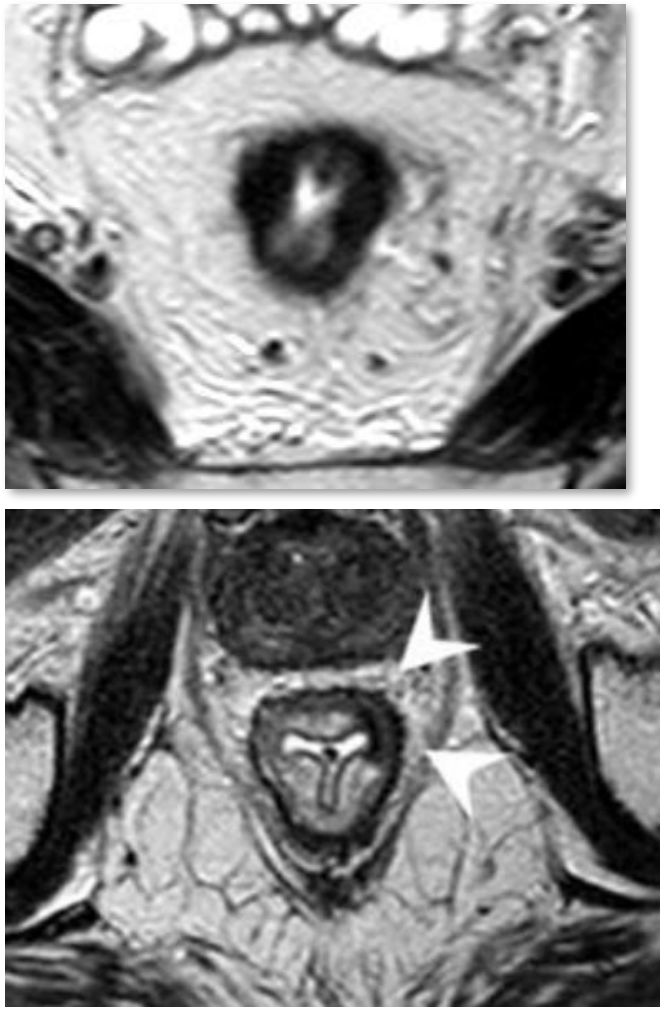
High risk features

Surgery

DWI MRI best method to identify cCR - real world evidence

postCRT MRI for cCR	Experts acc	Less Experts acc
mrTRG	**0.71**	**0.59**
Split scar	**0.70**	**0.65**
DWI MRI	**0.74**	**0.67**

22 radiologists , n=90, 10 centers



El Khababi et al. Eur Rad 2023

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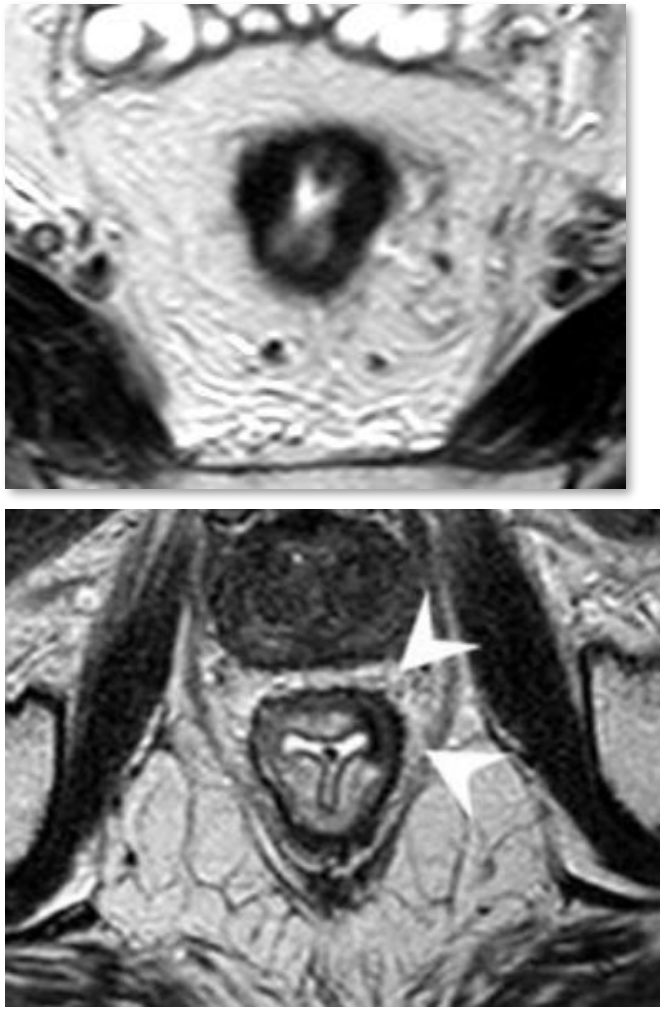
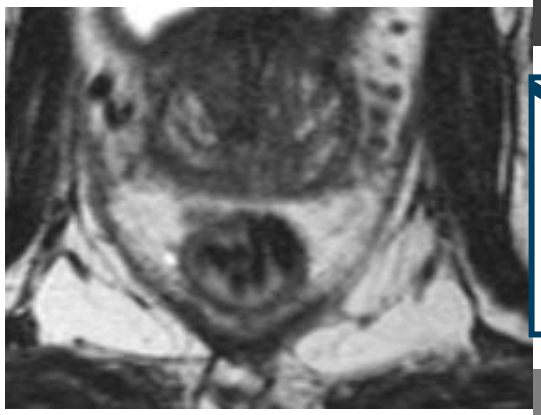
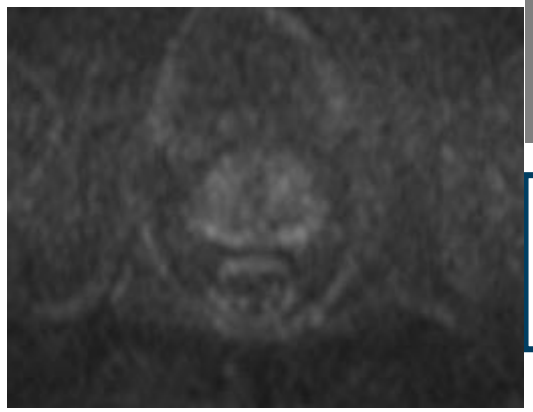
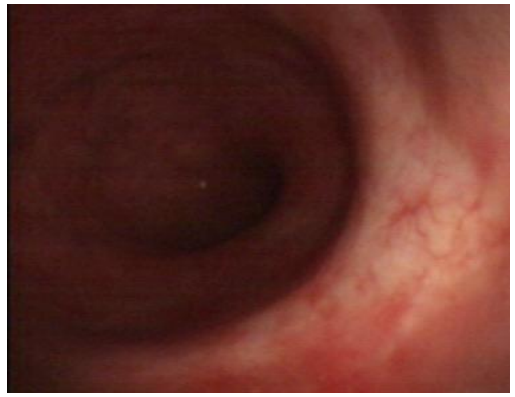


El Khababi et al. Eur Rad 2023

ORGAN PRESERVATION







cCR

Normalised rectal wall

Homoge

No diffus

Small residual

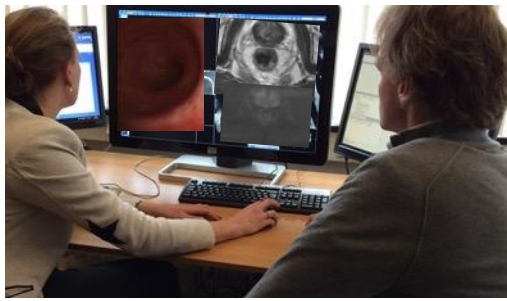
Clinical CR → DWI MRI

Homogeneous fibrosis

No diffusion restriction

Correlate with endoscopy

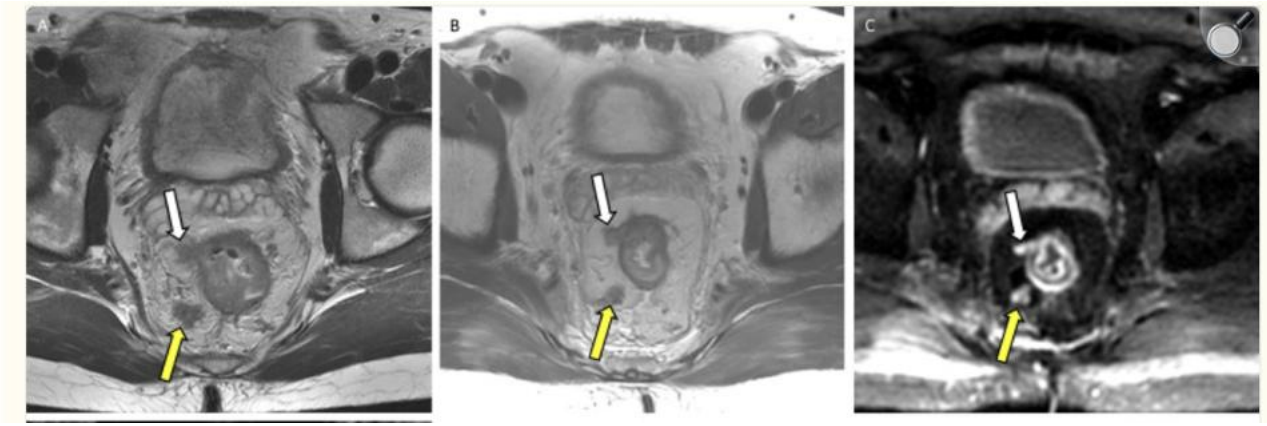
ORGAN PRESERVATION
Dig exam, endoscopy, DW MRI



ORGAN PRESERVATION : response evaluation

high risk features yEMVI+, TD, LLN+

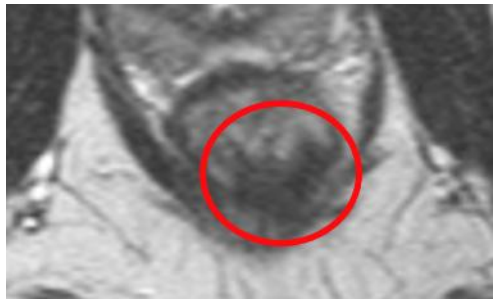
DWI helps for detection of yEMVI+,TD

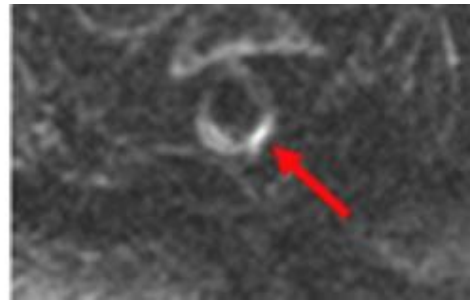


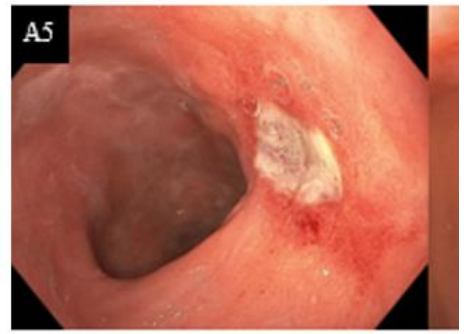
Small residual Tumor

sis &/or
restriction

eporting



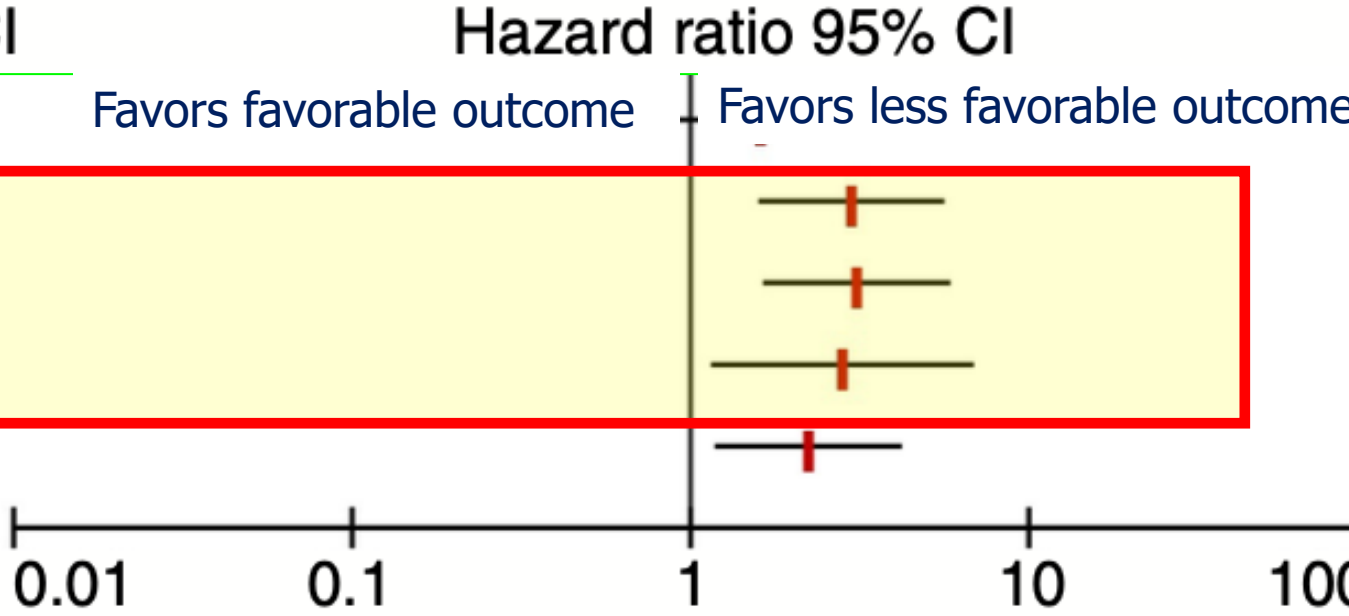




Kim et al, Radiology 2023

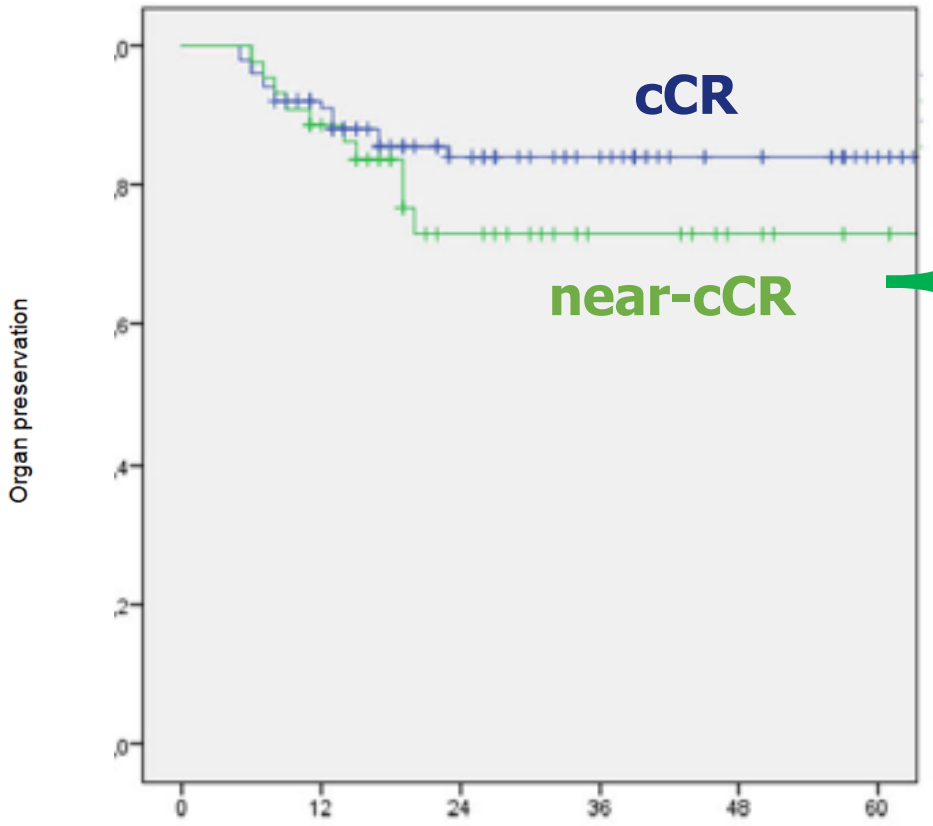
Restaging MR: yEMVI+, TD, Lateral LN+ have strongest association with less favorable 5yr OS

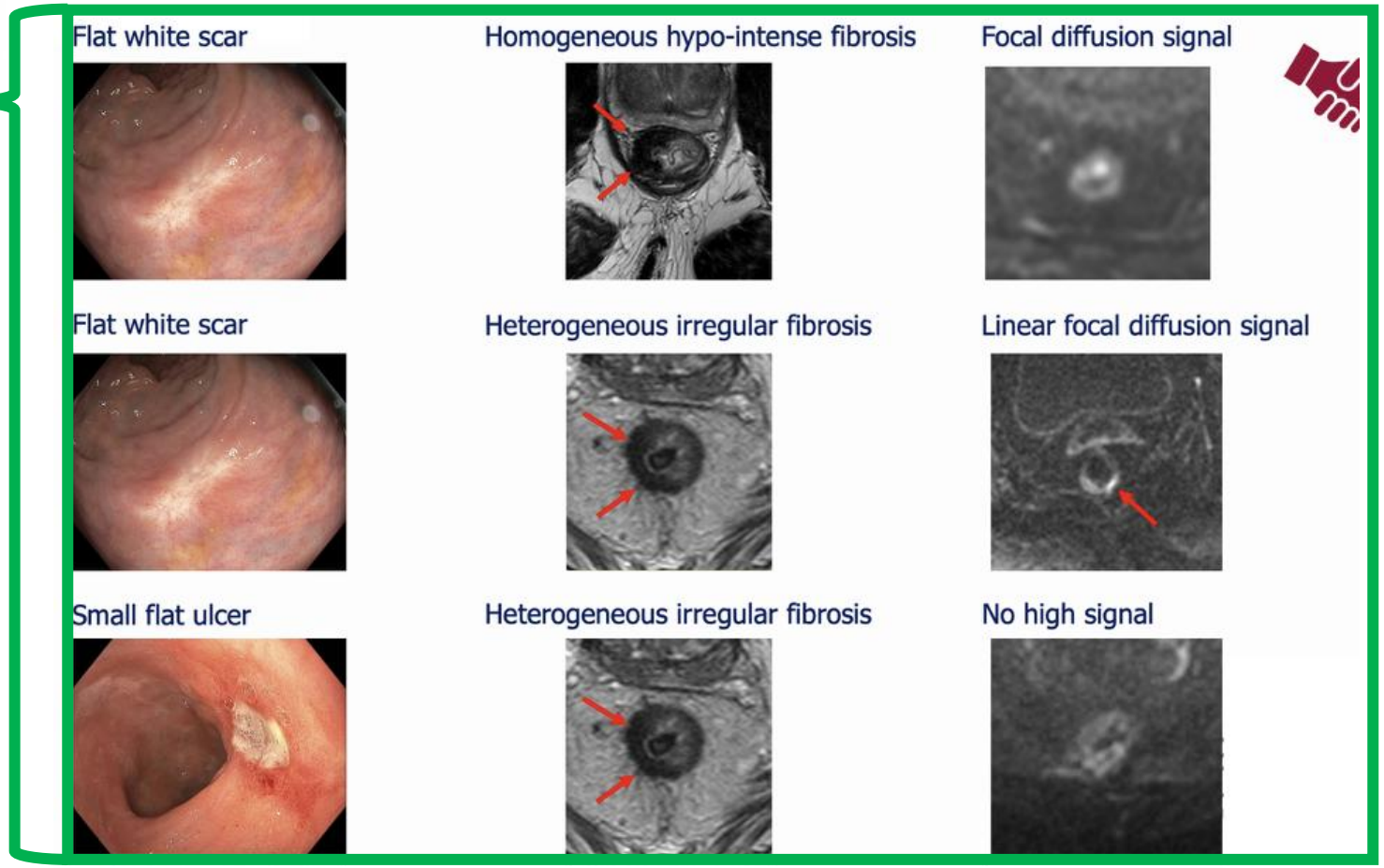
Variables	Hazard ratio 95% CI
y-mr-N	1.61 [0.77, 3.37]
y-mr-EMVI	2.99 [1.59, 5.62]
y-mr-TD	3.10 [1.64, 5.86]
y-PSW disease	2.81 [1.15, 6.87]
y-mrTRG	2.23 [1.18, 4.21]



Chandramohan et al. Colorectal Dis 2022

near-cCR slightly more residual tumor than cCR

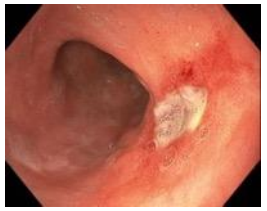


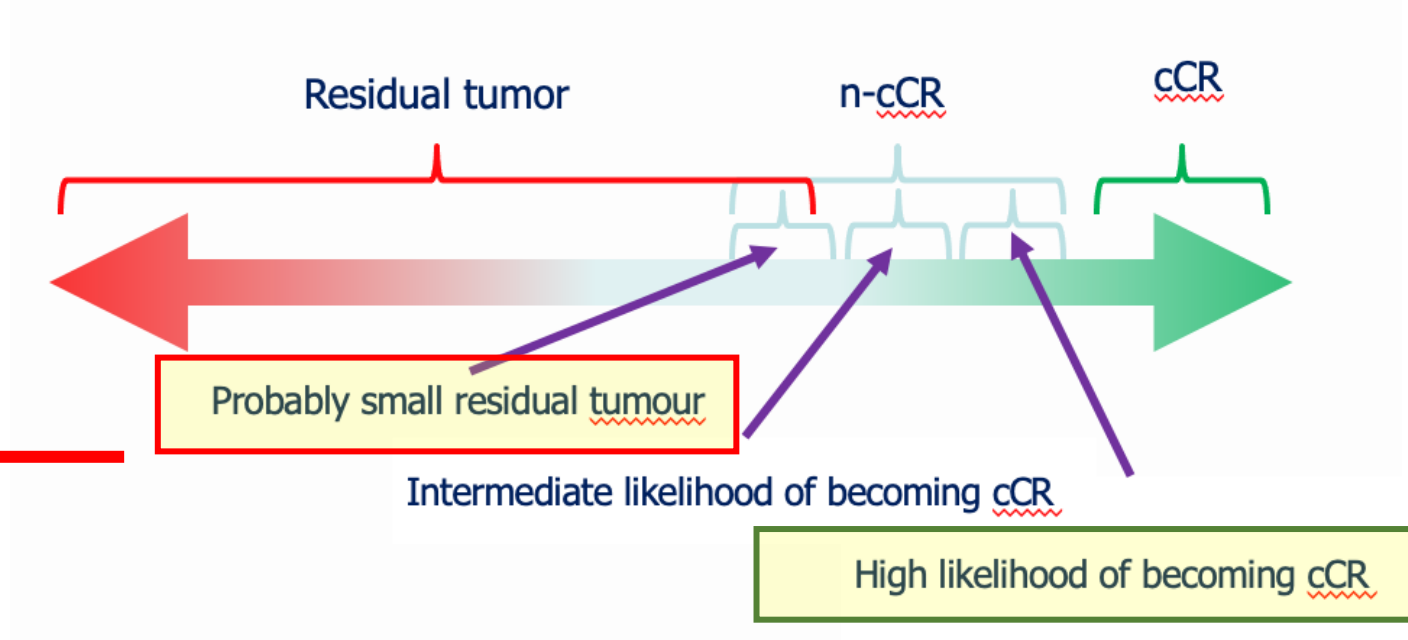


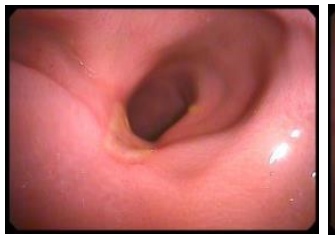
Hupkens et al. Ann Surg Oncol 2018
Custers et al, BJS 2022

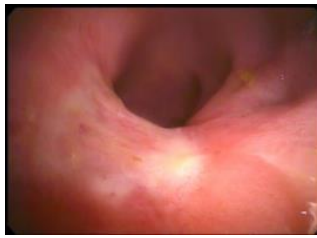
Consensus of experts

Near cCR: when at restaging very good response **potentially evolving to cCR**





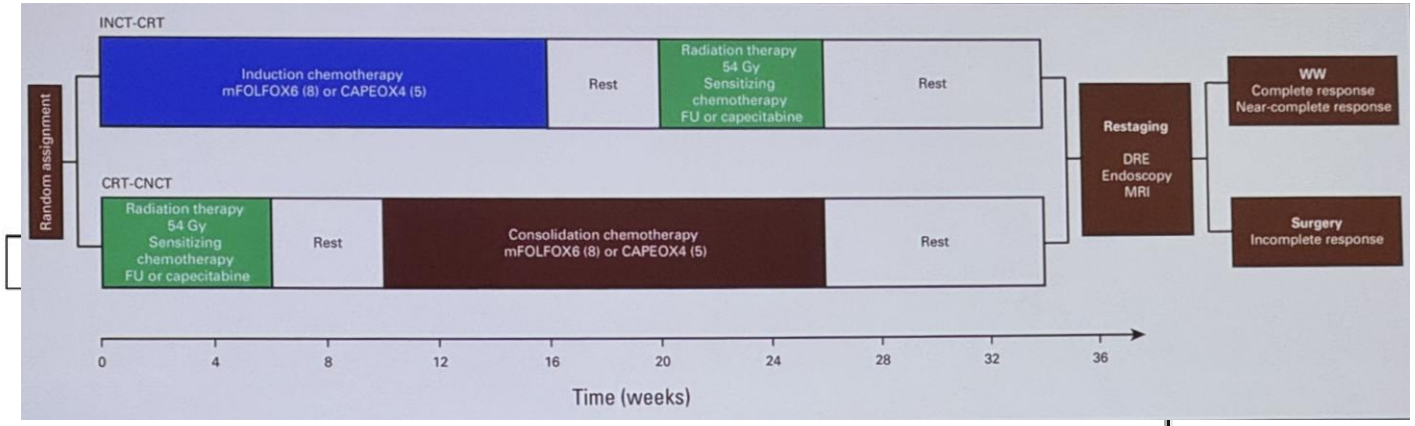


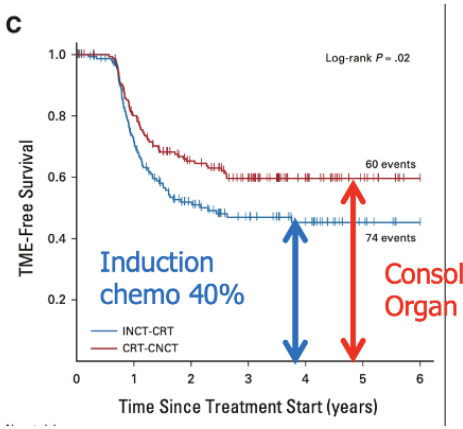


Caution !!

Watch & Wait

OPRA trial
induction vs consolidation chemo for st II/III





Garcia-Aguilar et al.
BMC Cancer 2015

116 mr-cCR

T2WI:
Normal appearing rectal wall *OR* only fibrosis (dark T2 signal)

DWI:
Absent signal on high b-value*

Lymph Node Status:
None or few nodes <5mm

125 mr-nCR

T2WI:
Mostly fibrosis with punctate areas of T2 intermediate signal

DWI:
Significant signal regression

Lymph Node Status:
Partial regression, but still ≥ 5mm

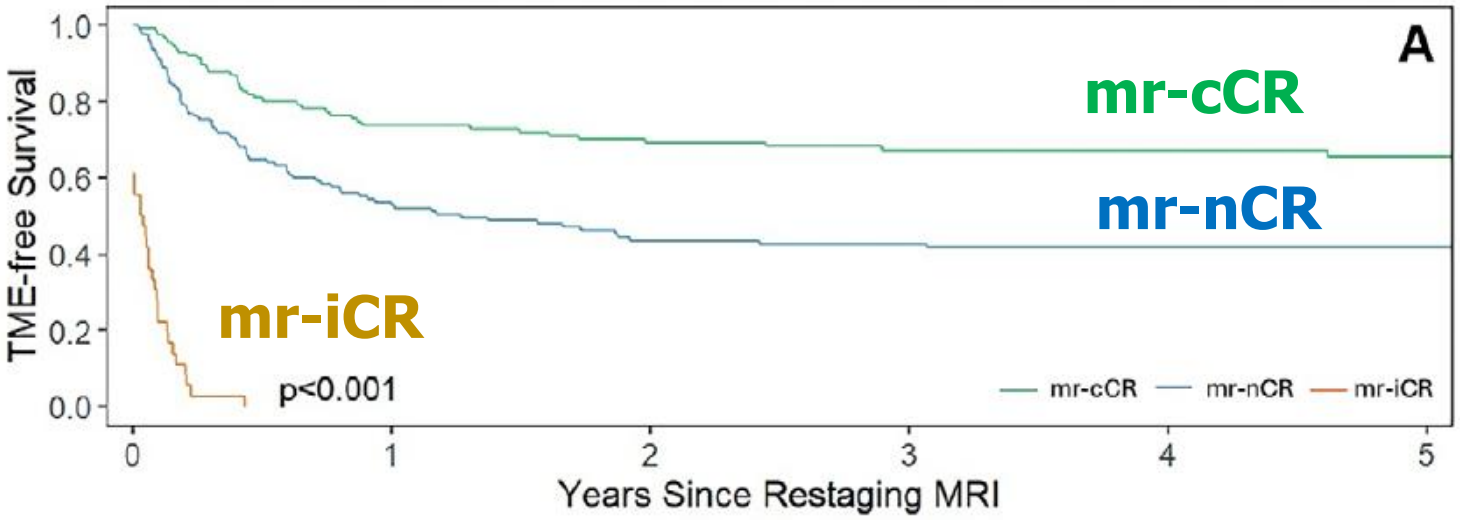
36 mr-iCR

T2WI:
Residual tumor with T2 intermediate signal

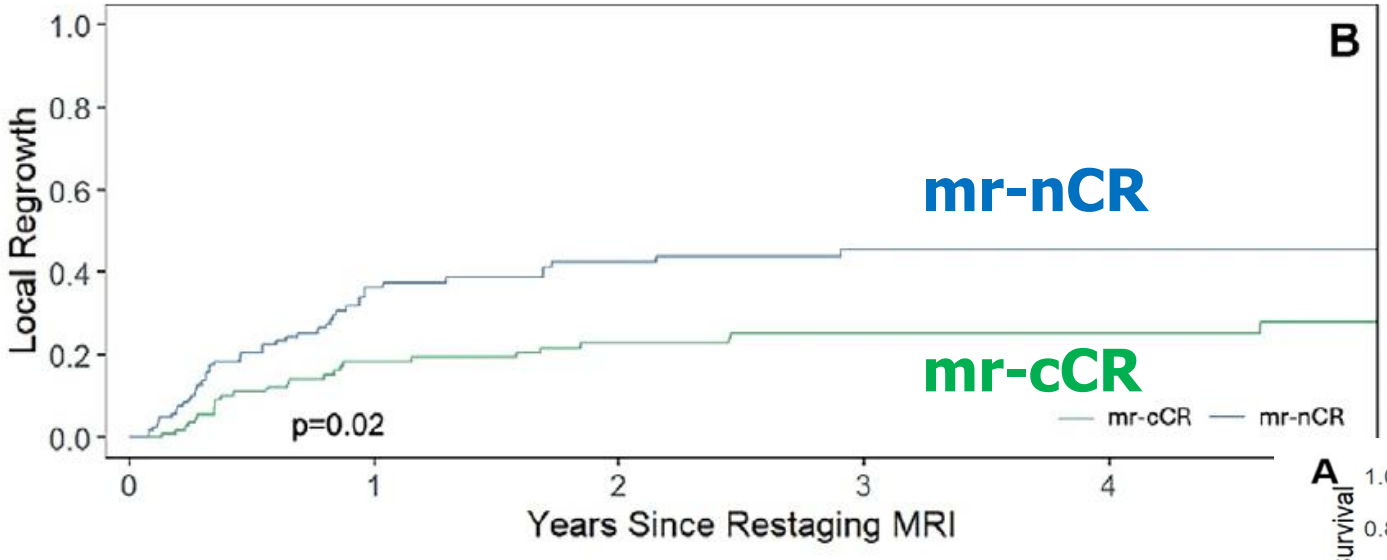
DWI:
Restricted diffusion present

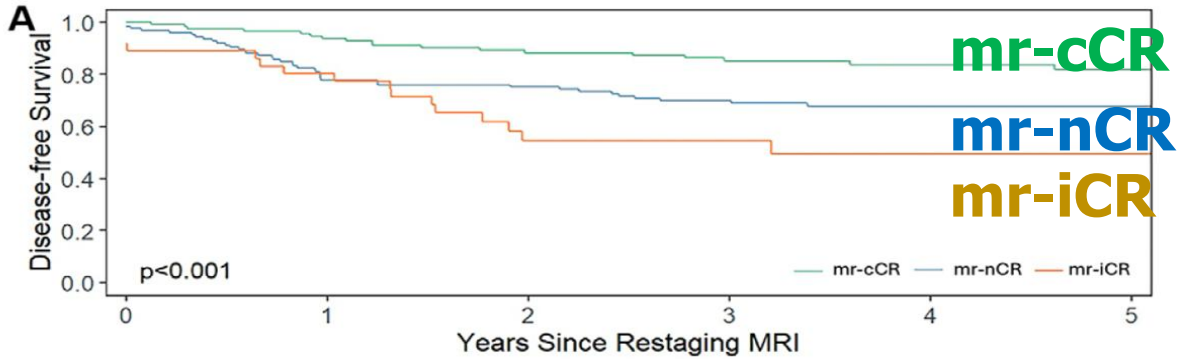
Lymph Node Status:
Persistently enlarged

Williams et al, Radiology 2024



post-TNT MRI predicts TME-free survival, local regrowth, outcomes





Williams et al, Radiology 2024

Residual Disease on MRI:
T2 intermediate signal, persistent DWI restriction or enlarged LN

MRI Characteristic	Participants with Imaging Characteristic	Complete Response (*n* = 137)	Residual Disease (*n* = 129)	*P* Value
Bowel wall at T2-weighted imaging				<.001
Normal bowel wall or only dark signal intensity	123	80 (65)	43 (35)	
Mostly dark signal intensity	109	51 (47)	58 (53)	
Mostly intermediate signal intensity	33	6 (18)	27 (82)	
Unknown	1	…	1 (100)	
Restricted diffusion at DWI				<.001
Absent	137	91 (66)	46 (34)	
Present (substantial regression)	87	35 (40)	52 (60)	
Present (no regression)	36	9 (25)	27 (75)	
Unknown	6	2 (33)	4 (67)	
Lymph node size				<.001
Not visible or <5 mm	200	119 (60)	81 (41)	
Partial regression	50	16 (32)	34 (68)	
Persistently enlarged	14	1 (7.1)	13 (93)	
Unknown	2	1 (50)	1 (50)	
Abnormal lymph node morphologic features*	24	4 (17)	20 (83)	<.001

Williams et al, Radiology 2024

But..over 1/3 of MR typical cCR still had residual disease

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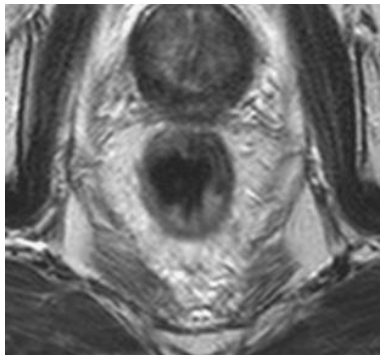
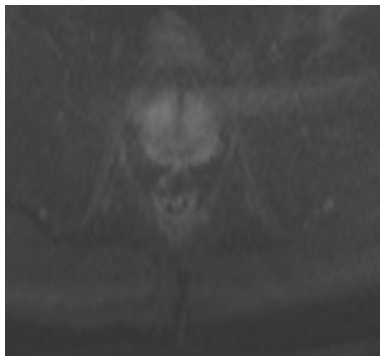




Williams et al, Radiology 2024

MRI assessment of rectal cancer response to neoadjuvant therapy: a multireader study

Jonathan B. Yuval[1], **Sujata Patil**[2], **Natalie Gangai**[3], **Dana M. Omer**[1], **Dmitriy G. Akselrod**[4], **Alice Fung**[5], **Carla B. Harmath**[6], **Rony Kampalath**[7], **Kyle Krehbiel**[8], **Sonia Lee**[7], **Peter S. Liu**[9], **John D. Millet**[10], **Ryan B. O'Malley**[11], **Andrei S. Purysko**[9], **Joseph C. Veniero**[9], **Ashish P. Wasnik**[10], **Julio Garcia-Aguilar**[1], **Marc J. Gollub**[3,✉]

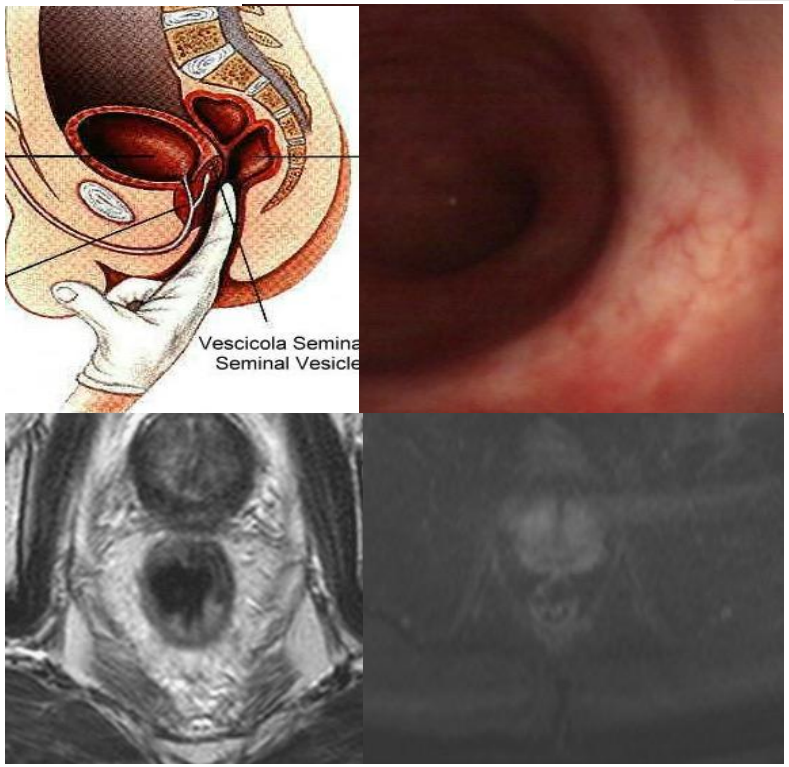
Eur Rad 2023

Methods: Twelve radiologists from 8 institutions assessed baseline and restaging MRI scans of 39 patients. The participating radiologists were asked to assess MRI features and to categorize the overall response as complete or incomplete. The reference standard was pathological complete response or a sustained clinical response for >2 years.

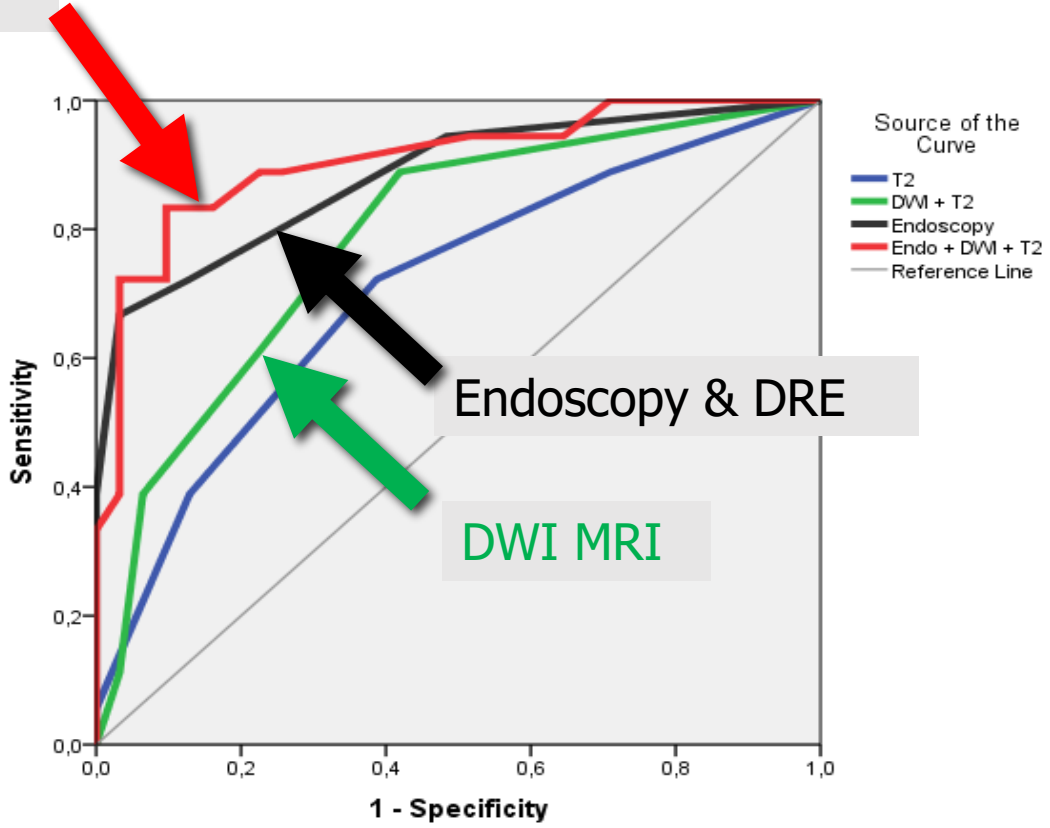
Results: We measured the accuracy and described the interobserver variability of interpretation of rectal cancer response between radiologists at different medical centers. Overall accuracy was 64%, with a sensitivity of 65% for detecting complete response and specificity of 63%

Conclusions: MRI-based evaluation of response at restaging is insufficiently accurate and has substantial variability of interpretation. Although some patients' response to neoadjuvant treatment on MRI may be easily recognizable, as seen by high accuracy and low variability, that is not the case for most patients.

Assessment of clinical Complete response after CRT

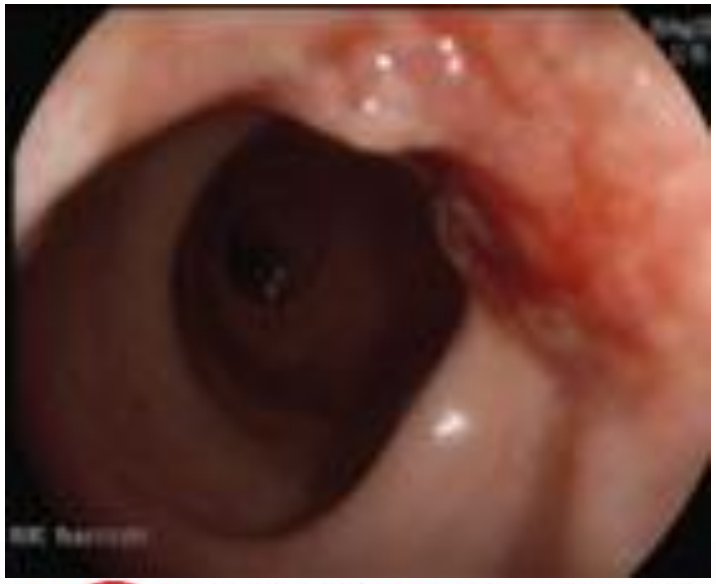


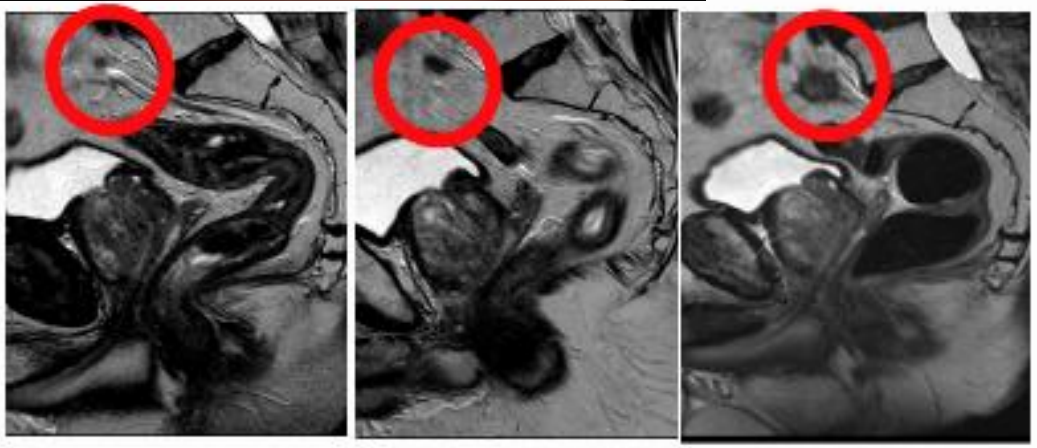
AUC 0.91

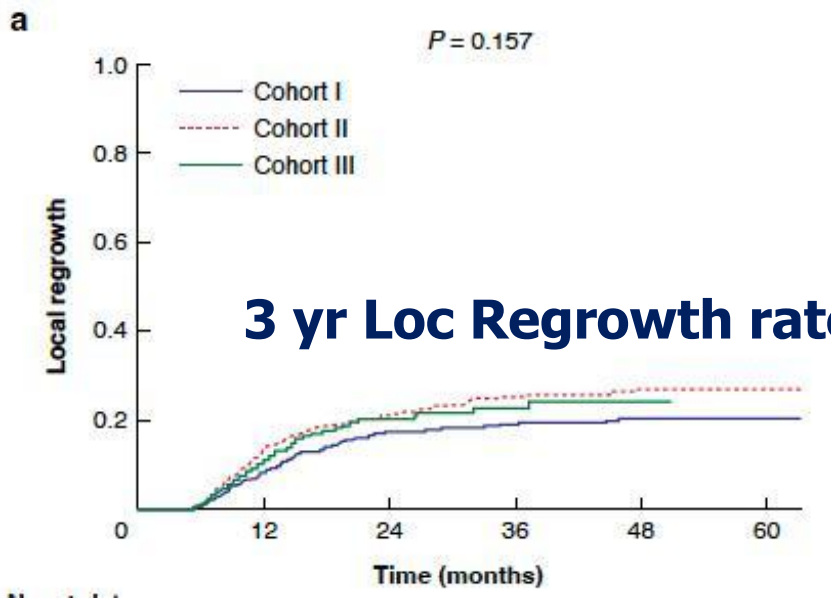


Maas et al Annals Surg Oncol 2015

Follow up & detection of Regrowth







3 yr Loc Regrowth rate 23%

Local regrowth, *n*	232 (22%)
Luminal	184 (79%)
Both	33 (14%)
Only nodal	15 (6%)
Distant metastases, *n*	101 (9%)

Geubels et al, BJS 2015

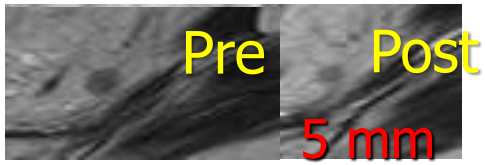
OPRA multivariate analysis→ MR abnormal nodal features independently associated with residual disease

Variable	Univariable Analysis				Multivariable Analysis			
	Total	No. of Events	Odds Ratio	*P* Value	Total	No. of Events	Odds Ratio	*P* Value
Age	266	129	0.99 (0.97, 1.01)	.22				
Female sex	266	129	0.79 (0.48, 1.31)	.36				
TNT treatment arm	266	129		.002	257	123		.01
Consolidation TNT			…				…	
Induction TNT			2.13 (1.32, 3.57)				2.00 (1.19, 3.45)	
Bowel wall at T2-weighted imaging	265	128		<.001	257			.6
Normal bowel wall or only dark signal intensity			…				…	
Intermediate signal intensity present			2.77 (1.69, 4.60)				1.22 (0.58, 2.49)	
Restricted diffusion at DWI	260	125		<.001	257	123		.01
Absent			…				…	
Present			3.55 (2.14, 5.97)				2.50 (1.22, 5.24)	
Lymph node size	264	128		<.001	257	123		.3
Not visible or <5 mm			…				…	
≥5 mm			4.06 (2.22, 7.74)				1.51 (0.72, 3.23)	
Abnormal lymph node morphologic features*	266	129	6.10 (2.23, 21.4)	.001	257	123	5.04 (1.43, 23.9)	.02

Williams et al, Radiology 2024

How to deal with nodes?

persistent suspicious mesorectal nodes



yc Lat N+

ycTD

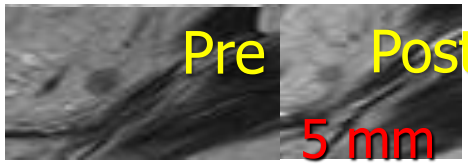
ycN0

Possibly ycN+

POTENTIAL ORGAN PRESERVATION

How to deal with nodes?

persistent suspicious mesorectal nodes



yc Lat N+

ycTD

ycN0

Possibly ycN+

POTENTIAL ORGAN PRESERVATION

Correlate with response of primary tumour

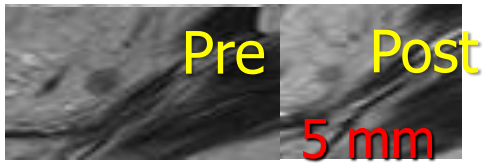
obvious residual tumour

ycN+

resection

How to deal with nodes?

persistent suspicious mesorectal nodes



yc Lat N+

ycTD

ycN0

Possibly ycN+

POTENTIAL ORGAN PRESERVATION

Correlate with response of primary tumour

CR, near-CR

ycN+

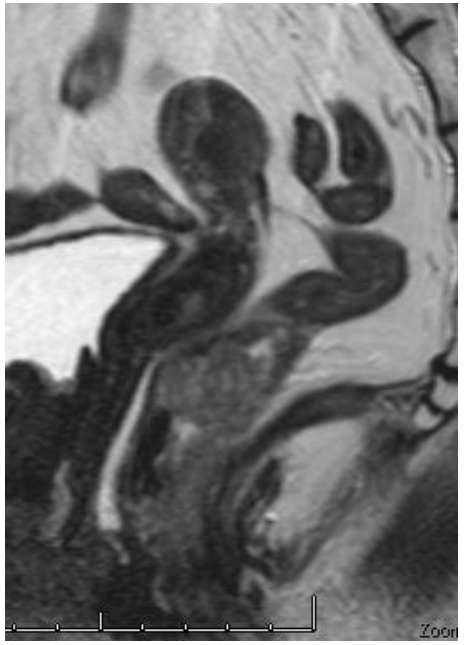
postpone decision for W&W

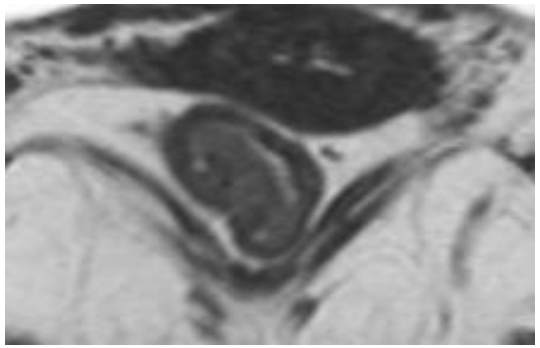
TEST of TIME

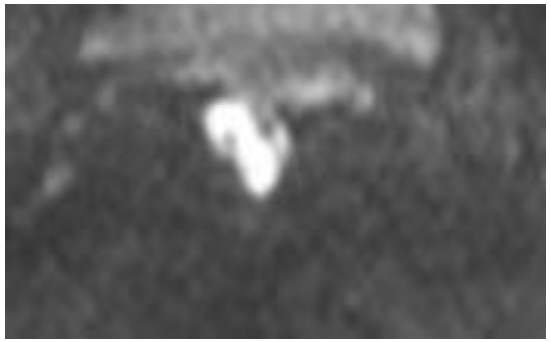
obvious residual tumour

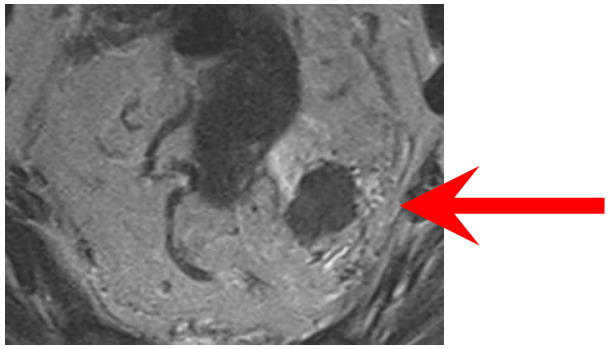
ycN+

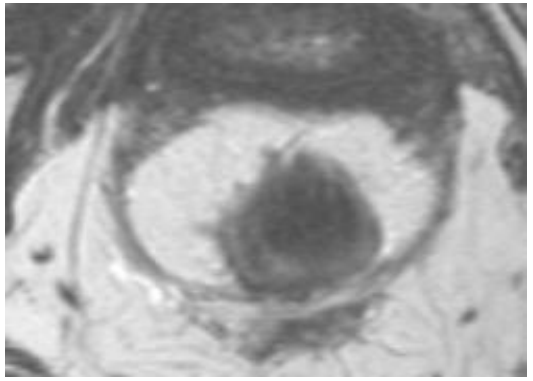
resection

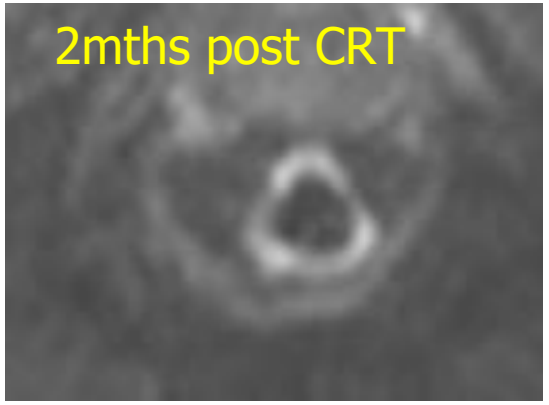


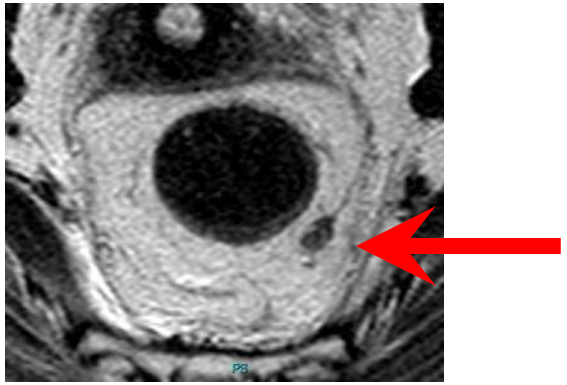


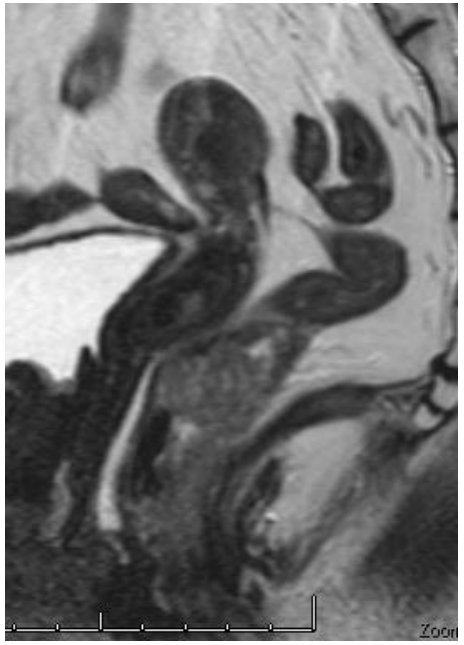


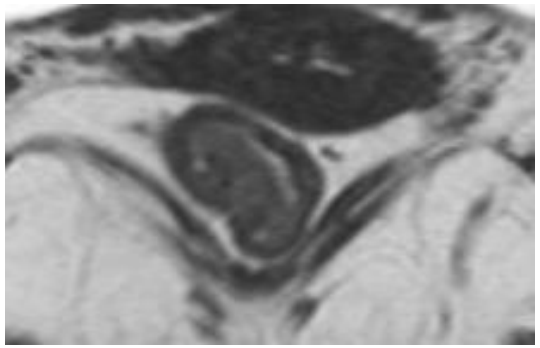


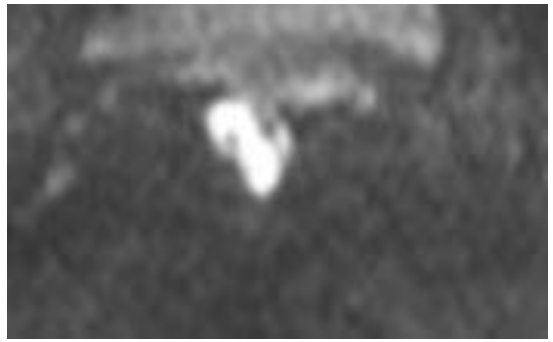


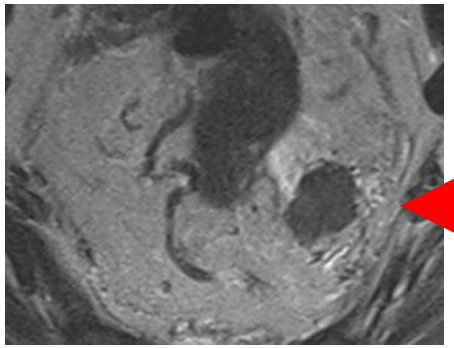

2mths post CRT

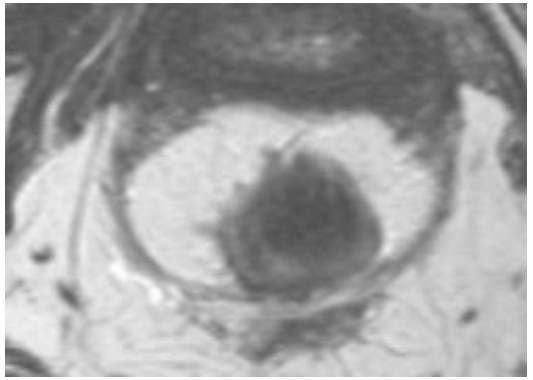


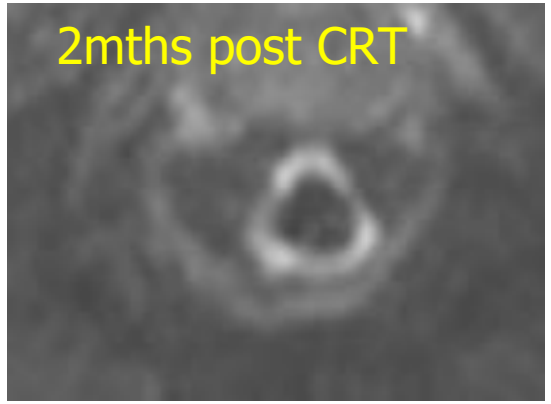


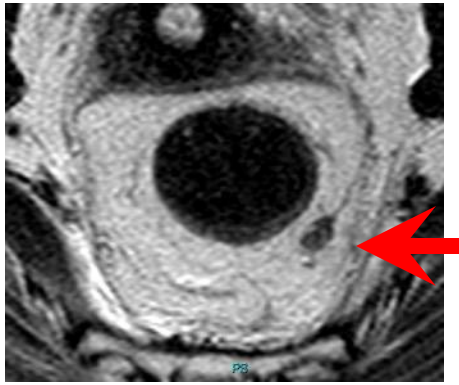


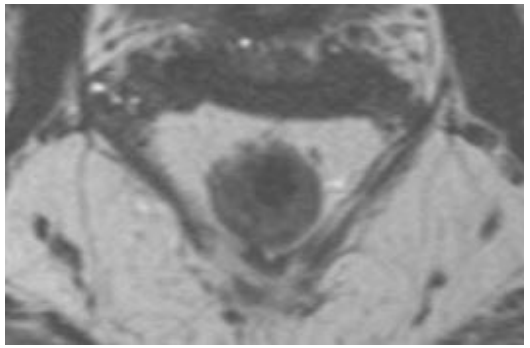


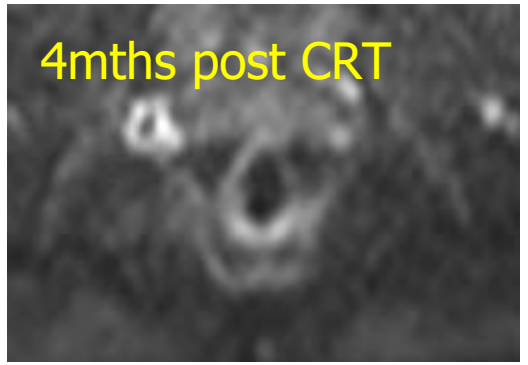


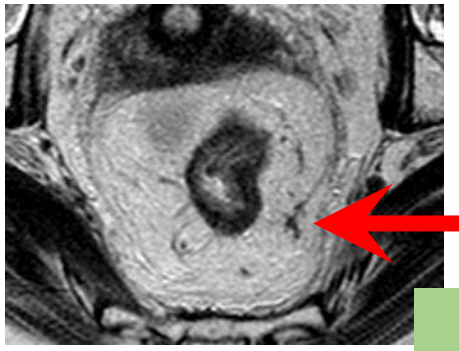












TEST of TIME

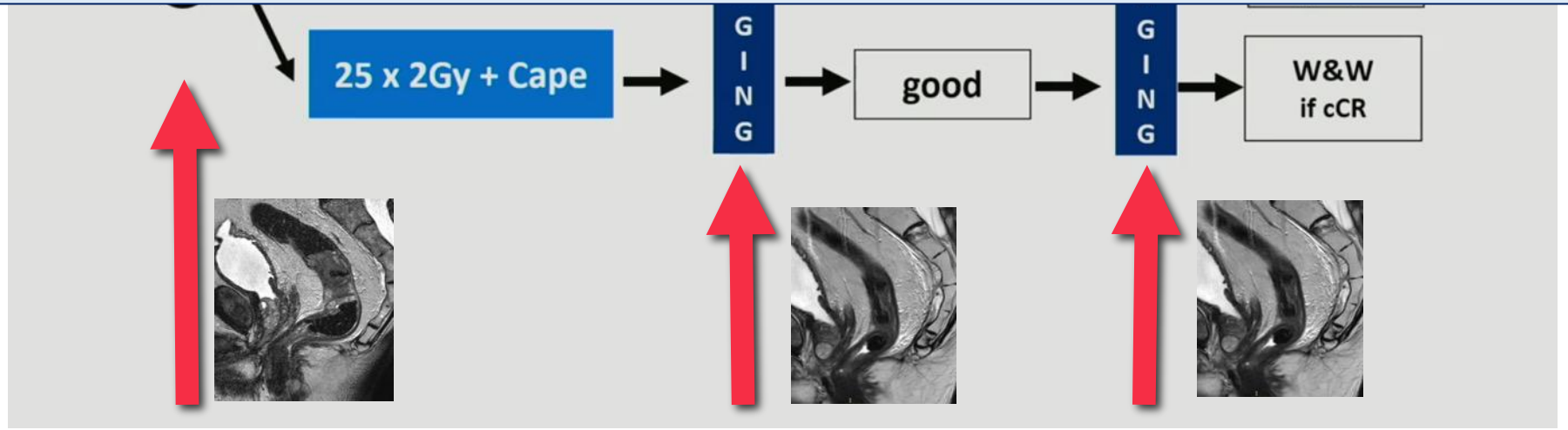
Primary Organ Preservation - smaller & earlier stage ca

Predict response at baseline

Predict response while on treatment

Assess response after completion neoadjuvant treatment

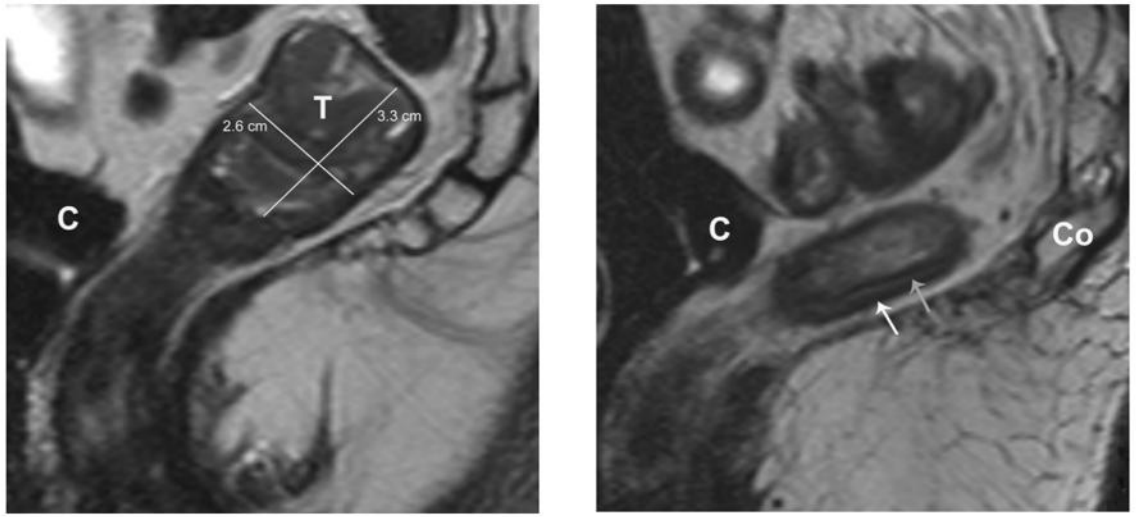
- Evaluation of response at multiple timepoints - allowing Rx adaptation
- no single accurate predictive biomarker



Bach et al. ASCO 2022

prediction of response

volume is a good predictor of response to RT



3x4cm tumors that shrinks >75%
are likely to respond very good (yT0-2)

Dresen et al Radiology 2009

response assessment during treatment

	Poor responders ($n = 19$)	Good responders ($n = 24$)	Complete responders ($n = 22$)
V_{pre}	46.4 ± 56.0	32.2 ± 16.8	21.7 ± 15.6
V_{mid}	26.4 ± 34.0	15.2 ± 9.1	7.2 ± 5.8

Fiorino et al. Radiother Oncol 2018

response assessment during treatment

	Poor responders ($n = 19$)		Good responders ($n = 24$)		Complete responders ($n = 22$)
V_{pre}		46.4 ± 56.0		32.2 ± 16.8	21.7 ± 15.6
V_{mid}	-43% ↓	26.4 ± 34.0	-53% ↓	15.2 ± 9.1	-67% ↓ 7.2 ± 5.8

Fiorino et al. Radiother Oncol 2018

baseline MR cN+, EMVI+, MRF+, tumor length independently predict failure of non-operative management

Williams et al, BJS 2024

	Univariable analysis				Backwards-selected multivariable analysis			
	No. of patients	No. of events	HR*	P	No. of patients	No. of events	HR*	P
Age (years)	324	162	0.99 (0.98, 1.00)	0.2				
Female sex	324	162	1.07 (0.78, 1.48)	0.7				
Induction TNT	324	162	1.47 (1.08, 2.00)	0.013	309	155	1.35 (0.98, 1.85)	0.065
Tumour grade	324	162						
Low			1.00 (reference)					
High			1.34 (0.71, 2.55)	0.4				
Not reported			0.59 (0.33, 1.06)	0.08				
Interval from end of TNT to restaging (days)	300	156	1.00 (0.99, 1.01)	> 0.9				
Distance from anal verge (cm)	320	160	0.98 (0.93, 1.05)	0.6				
Largest tumour length (cm)	320	159	1.17 (1.07, 1.28)	< 0.001	309	155	1.11 (1.00, 1.22)	0.044
cT category	324	162						
T1 or T2			1.00 (reference)					
T3			1.69 (0.95, 2.99)	0.07				
T4			2.30 (1.16, 4.53)	0.017				
Mesorectal fascia	311	156			309	155		
Clear			1.00 (reference)				1.00 (reference)	
Threatened			0.88 (0.53, 1.48)	0.6			0.80 (0.47, 1.34)	0.4
Involved			1.63 (1.15, 2.32)	0.006			1.45 (1.01, 2.09)	0.043
Not applicable			0.88 (0.45, 1.72)	0.7			0.95 (0.49, 1.86)	0.9
cN-positive	324	162	1.73 (1.18, 2.52)	0.005	309	155	1.66 (1.12, 2.48)	0.012
EMVI	324	162			309	155		
Absent or indeterminate			1.00 (reference)				1.00 (reference)	
Present			1.80 (1.26, 2.56)	0.001			1.57 (1.07, 2.29)	0.020
Not reported			1.24 (0.71, 2.17)	0.4			1.16 (0.63, 2.13)	0.6

Baseline MRI features predicting pCR post CRT

- mrT2-3 (OR 6.41, 95% CI 3.17–12.97)
- tumor circumference < ½ (OR 2.11, 95% CI 1.44–3.09)
- mrN0 (OR 2.17, 95% CI 1.48–3.18)
- MRF- (OR 3.21, 95% CI 2.06–5.01)
- EMVI - (OR 5.68, 95% CI 3.50–9.21)
- diameter < 36 mm (OR 2.10, 95% CI 1.48–3.17)

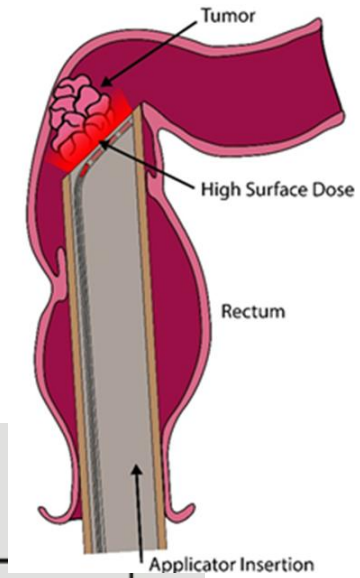
Li et al, Int J Colorect Dis 2025

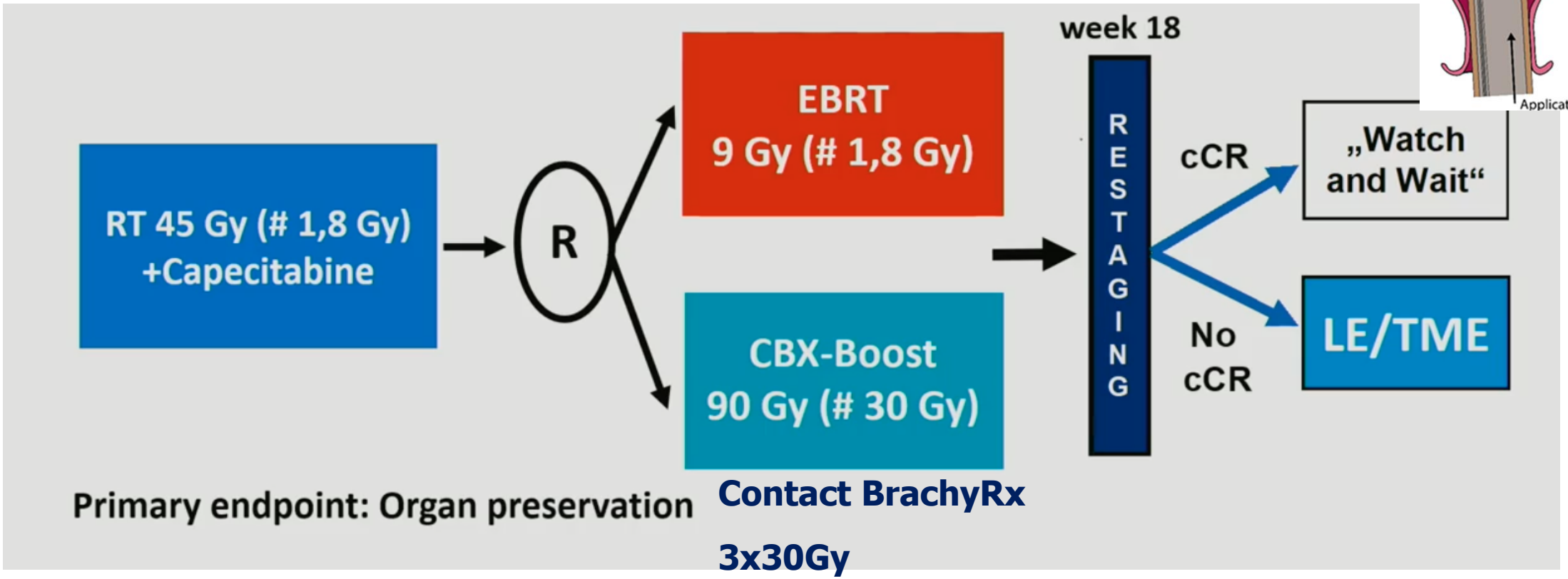
Towards more organ preservation…

how to increase cCR?

OPERA trial: external vs contact boost

cT2-3b, N0-1, <5cm, <50% circumference





Gerard et al. Lancet Gastro Hep 2023

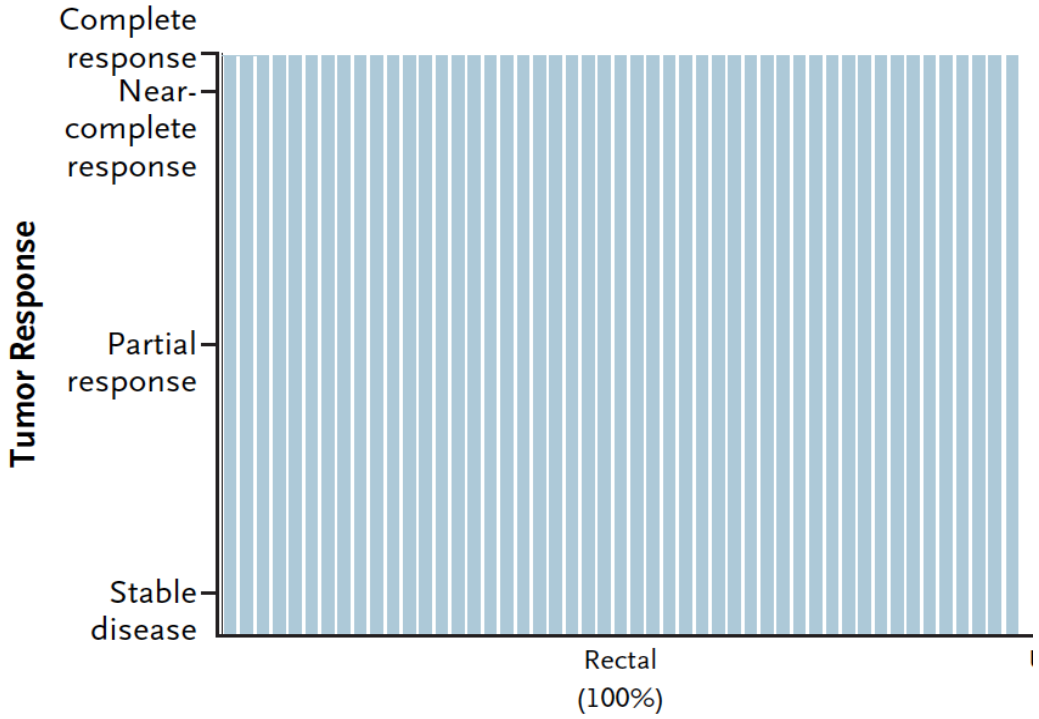
Median Fup 38.2 mths	CRT+EBRT N=69	**CRT+Contact RT** N=72
3yr Organ preservation (all pats)	59%	**81%**
3 yr Organ preservation T<3cm	63%	**97%**
Poor LARS (incontinence score)	21%	17%

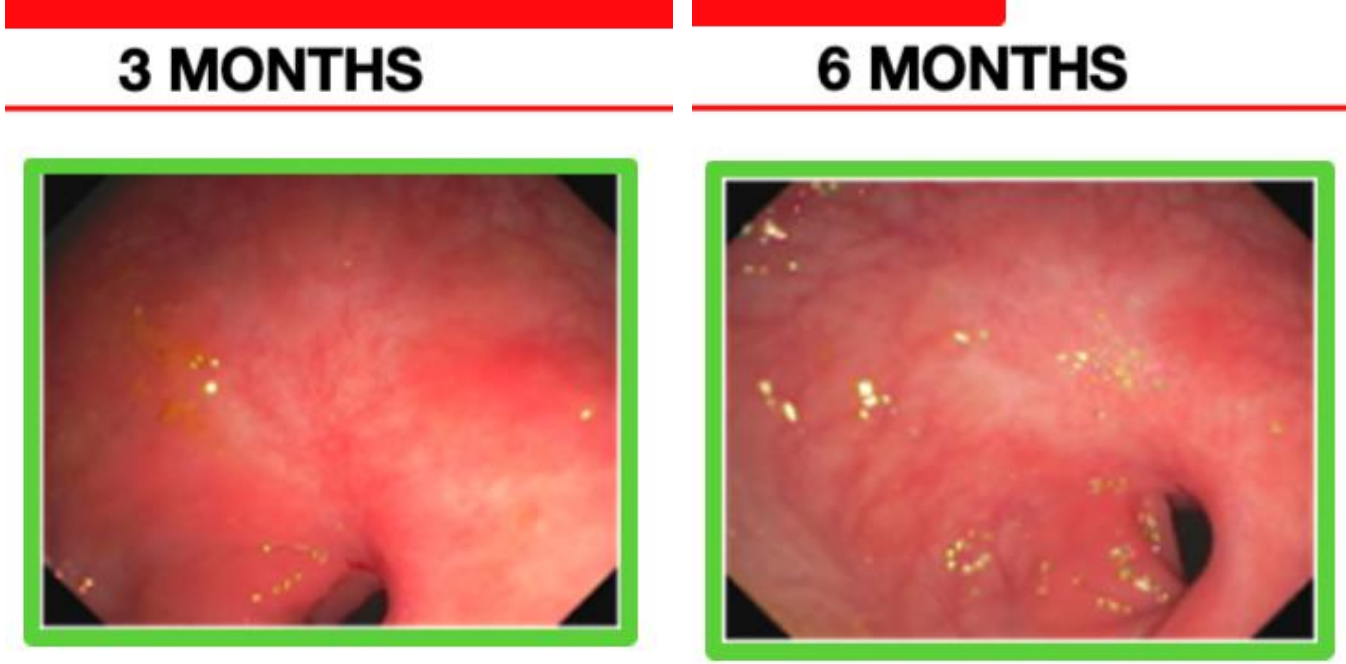
Gerard et al. Lancet Gastro Hep 2023

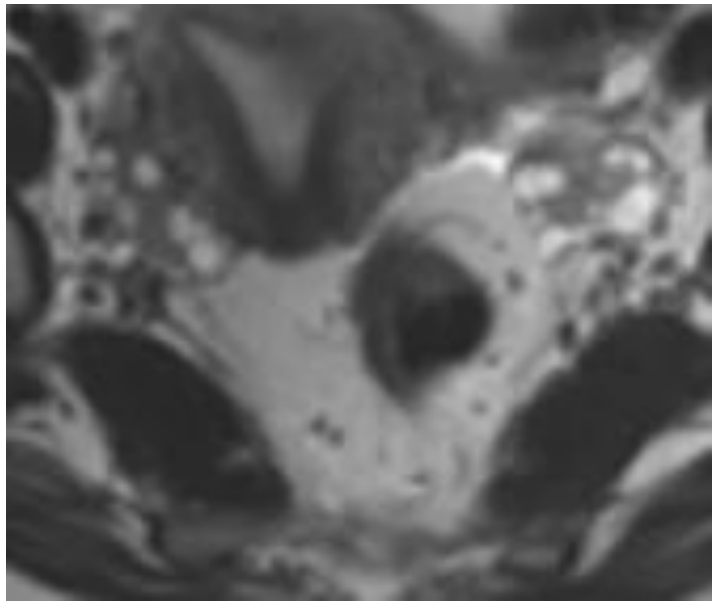
Immunotherapy – new challenges

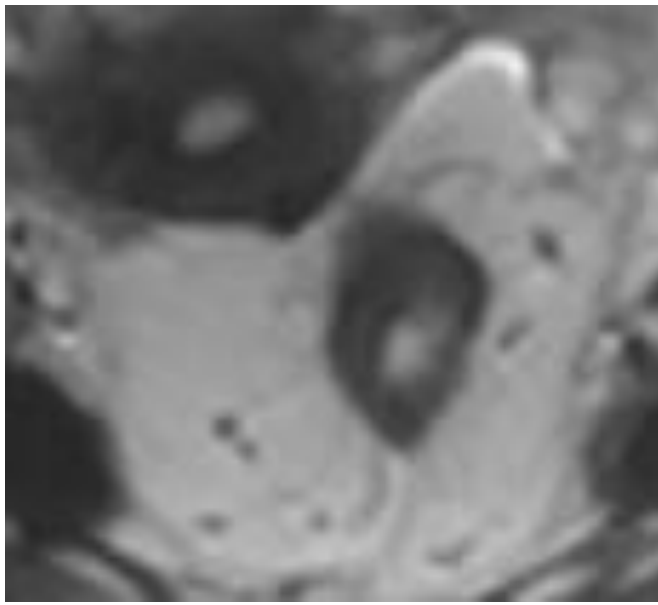
100% cCR for dMMR/MSI

→ 5-10% of all rectal ca









Cercek et al. N Engl J Med April 2025

Radiotherapy as immuno-modulator for **majority pMMR/MSS rectal ca**

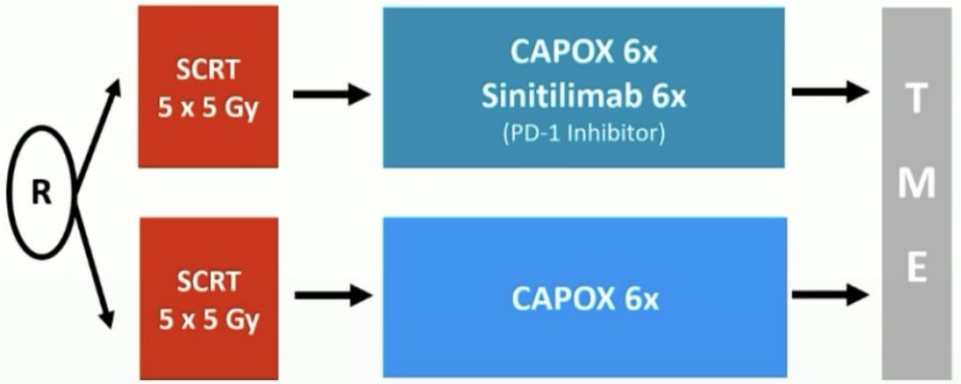
combined RT-ICI trials

Trial registration (phase)	N	Drug/Schedule	Primary endpoint
NCT03127007 (I/II)	54	5-FU CRT +/- Atezolizumab *(PD-L1 ICI)*	Toxicity pCR
NCT03102047 (II)	47	5-FU CRT followed by Durvalumab *(PD-L1 ICI)*	NAR score
NCT04109755 (II)	25	SCRT (5 x 5 Gy) + Pembrolizumab *(PD-1 ICI)*	TRG
NCT02921256 (II)	90	Induction FOLFOX followed by Cape CRT + Pembrolizumab	NAR score
NCT03916510 (I)	30	5-FU CRT + Enadenotucirev *(chimeric oncolytic adenovirus)*	Toxicity
NCT02688712 (II)	50	5-FU CRT + Galunisertib *(TGF-β receptor I kinase inhibitor)*	pCR

Courtesy E. Fokas

SPRING-01 cT3-4 or N+, **pMMR**, n=49

5x5Gy+ICI
→ 60% pCR/cCR

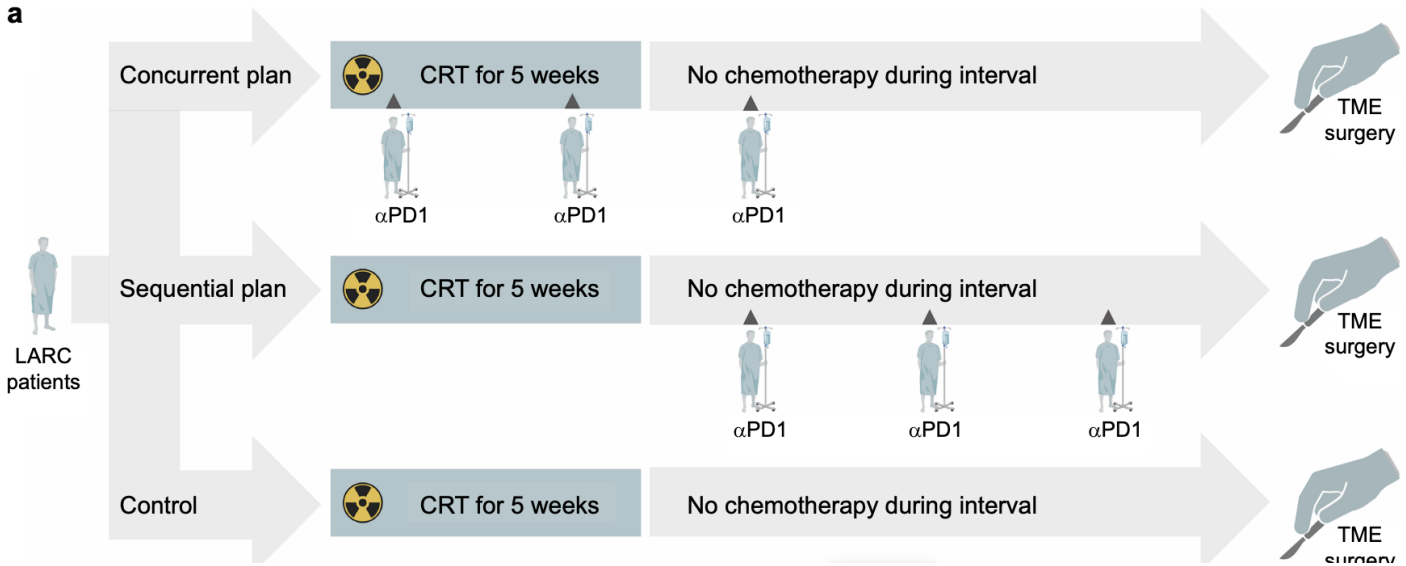


	Sintilimab plus capecitabine–oxaliplatin (n=49)	Capecitabine–oxaliplatin (n=49)	Odds ratio (95% CI)	p value
Intention-to-treat population				
Pathological complete response (ypT0N0)	29 (59·2%; 95% CI 45·4–72·9)	16 (32·7%; 95% CI 19·5–45·8)	3·0 (1·3–6·8)	0·015*
Complete response†	30 (61·2%; 95% CI 48·2–72·9)	16 (32·7%; 95% CI 21·3–46·2)	3·2 (1·4–7·5)	0·0085*
Major pathological response	36 (73·5%; 95% CI 60·3–83·5)	23 (46·9%; 95% CI 34·0–60·2)	3·1 (1·3–7·3)	0·013*

Tian et al, Lancet Oncol 2025

POLARSTAR st II/III, **pMMR**, n=186

sequential ICI is more effective than concurrent ICI



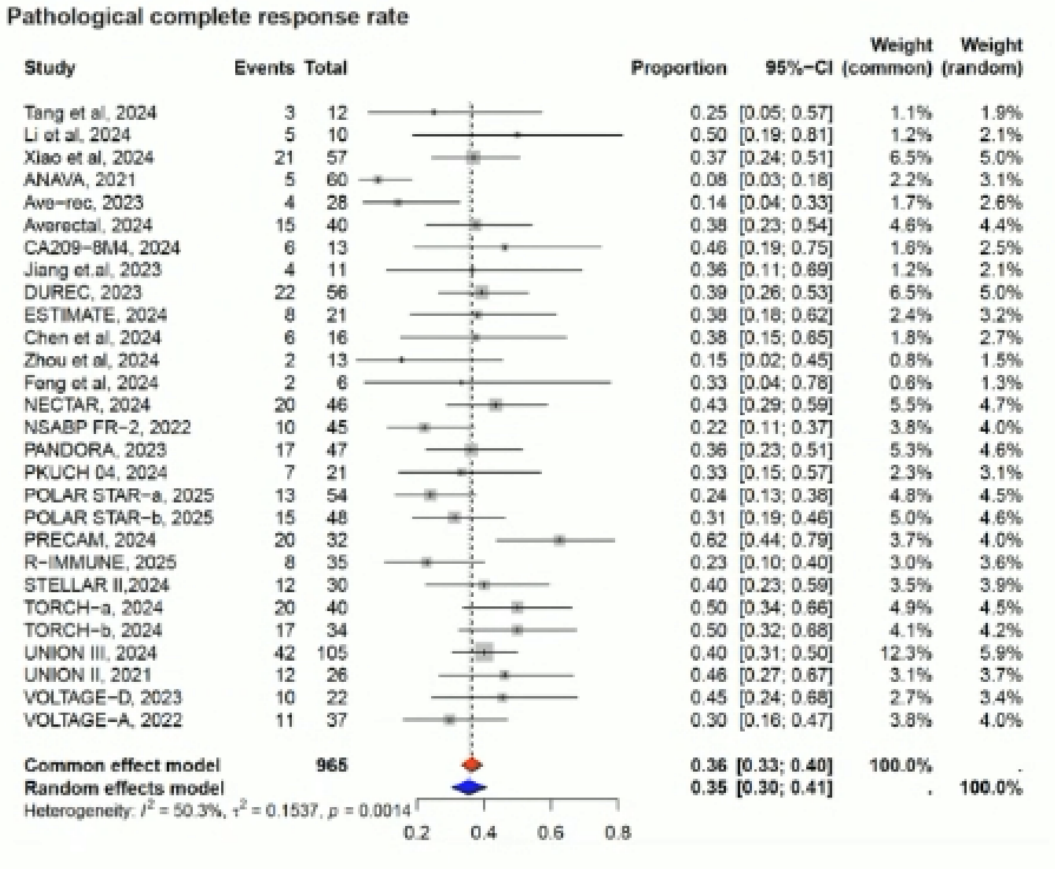
33% pCR

39% pCR

20% pCR

Pang et al, BJS 2025

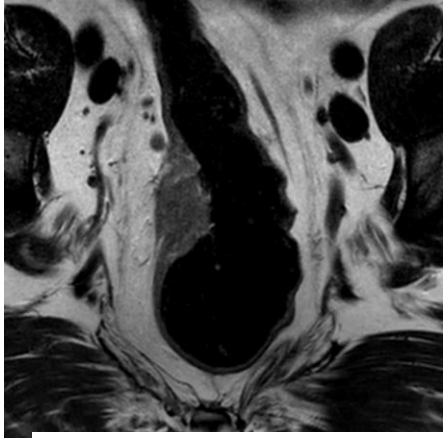
RT/ICI in **pMMR Rectal Cancer – meta analysis**

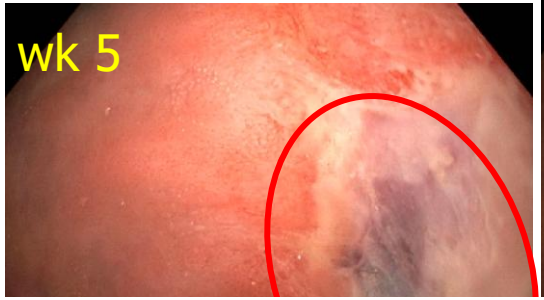


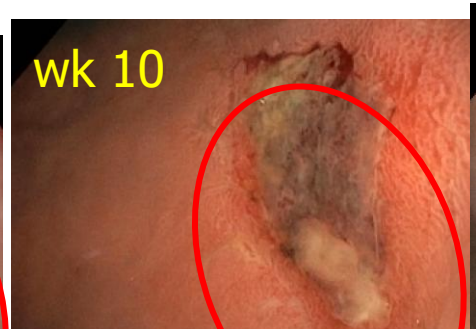
- Pooled analysis of 965 prospective trials
- Addition of ICI to RT/CRT/TNT increased pCR/cCR up to 50%
- If RT combined with sequential ICI: pCR/cCR rates higher after 5x5Gy (than CRT)

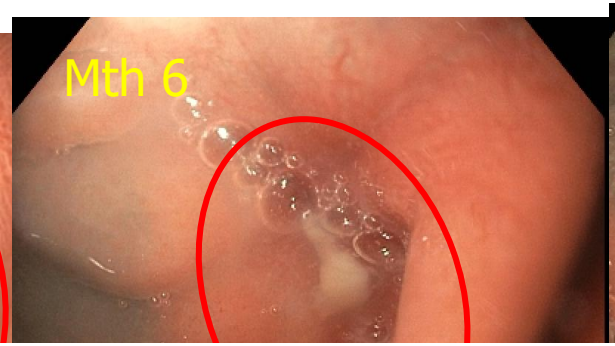
Jia et al, CCR 2026

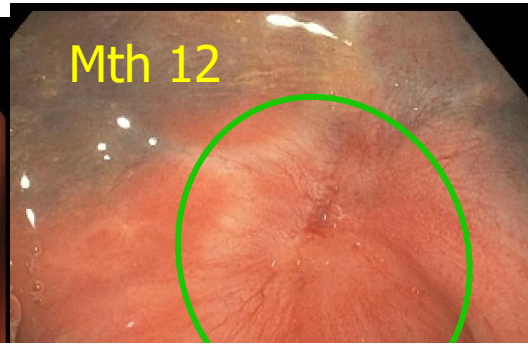
RT + immunotherapy









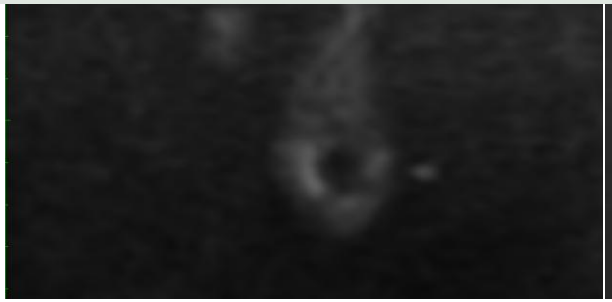


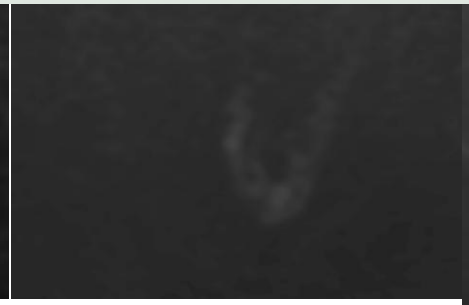
Evaluating MRI response criteria in microsatellite instability-high rectal cancer treated with immune checkpoint inhibitors

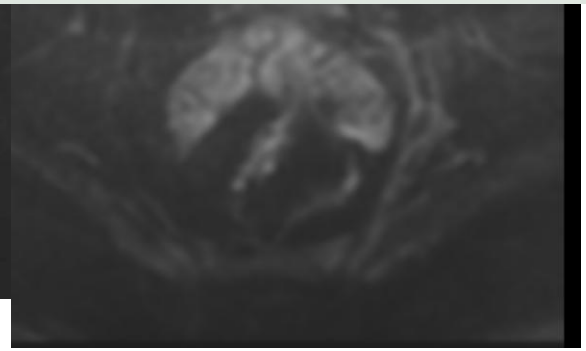
Q. Vanderbecq[1,2], R. Cohen[3,4], M. Camus[5], X. Dray[5], P. Yann[6], T. André[3,4*] & M. Wagner[1,2]

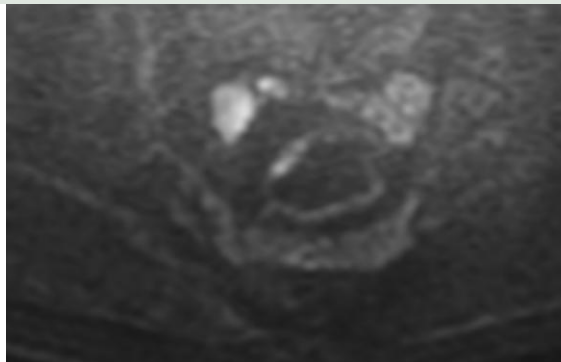
Esmo Open 2026

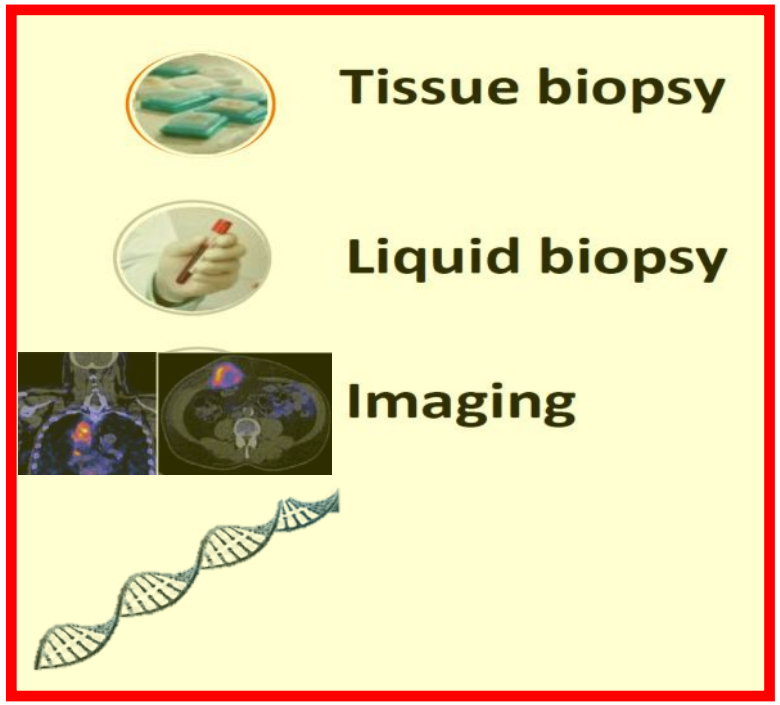
Conclusions: MRI response patterns after anti-PD-1 monotherapy in MSI-H/dMMR rectal cancer differ from those observed after radiochemotherapy, suggesting the need to adapt current imaging criteria for accurate response assessment and informed surgical decision making. Persistent MRI abnormalities are frequent despite complete pathological response, and warrant cautious interpretation in the ICI setting.







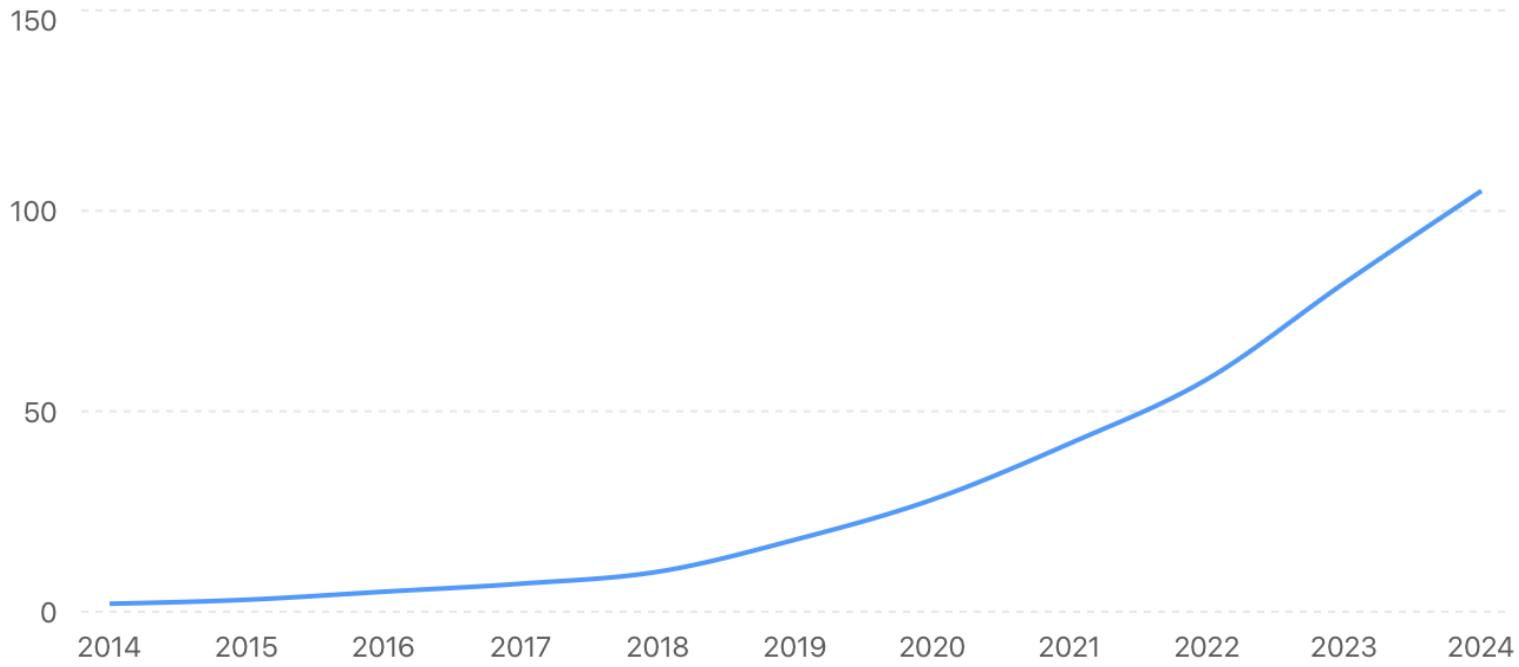




Multimodal AI prediction model of outcome

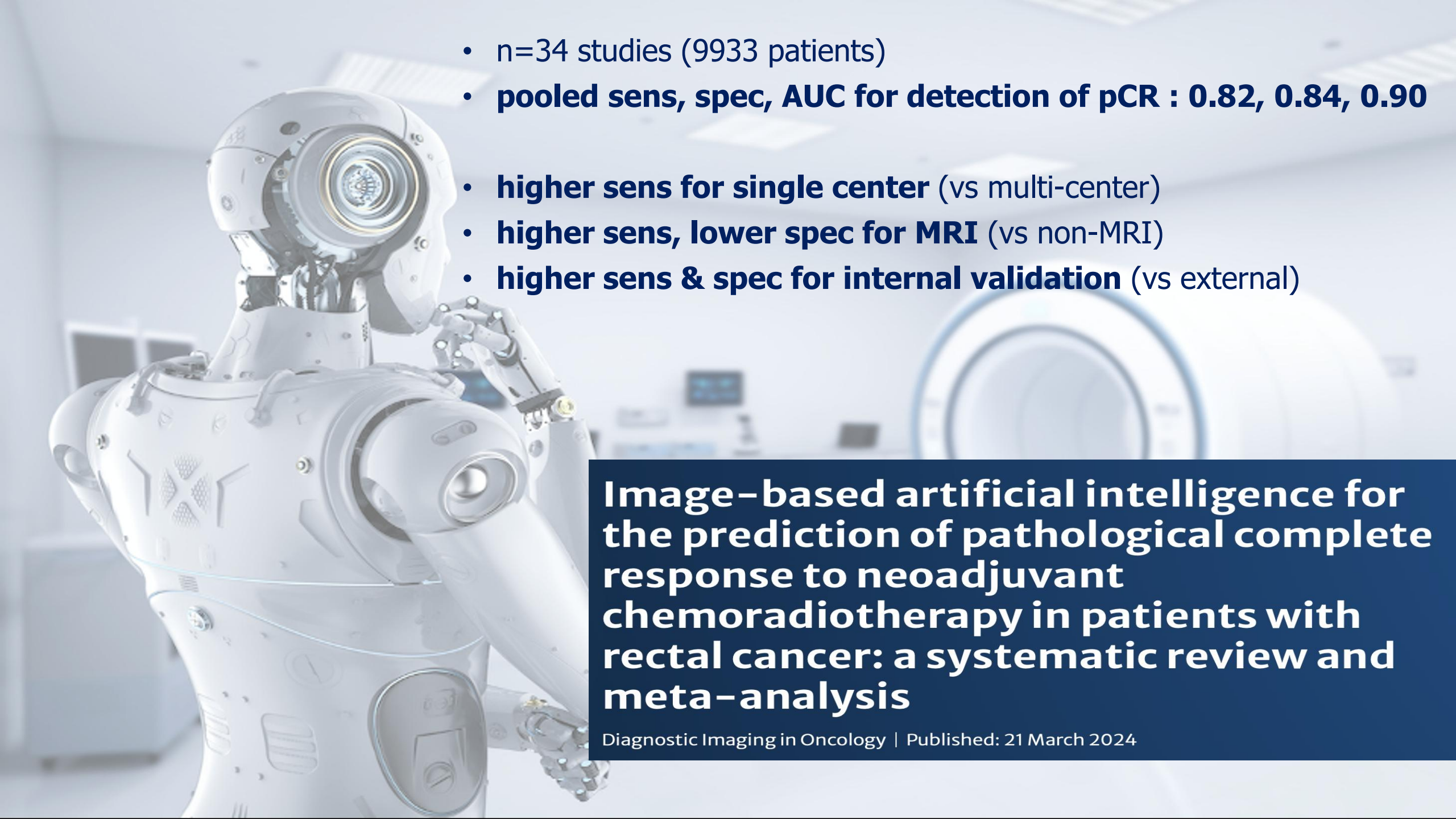
diagnostic data fused within an intelligent AI-framework

Trend in Growth of AI publications in Rectal cancer Imaging



The main areas of growth:

- MRI-based TN staging
- Assessment of pCR after neoadjuvant therapy
- Prediction of cCR for watch-and-wait strategies
- Multimodal AI predictive models



- n=34 studies (9933 patients)
- **pooled sens, spec, AUC for detection of pCR : 0.82, 0.84, 0.90**

- **higher sens for single center** (vs multi-center)
- **higher sens, lower spec for MRI** (vs non-MRI)
- **higher sens & spec for internal validation** (vs external)

Image-based artificial intelligence for the prediction of pathological complete response to neoadjuvant chemoradiotherapy in patients with rectal cancer: a systematic review and meta-analysis

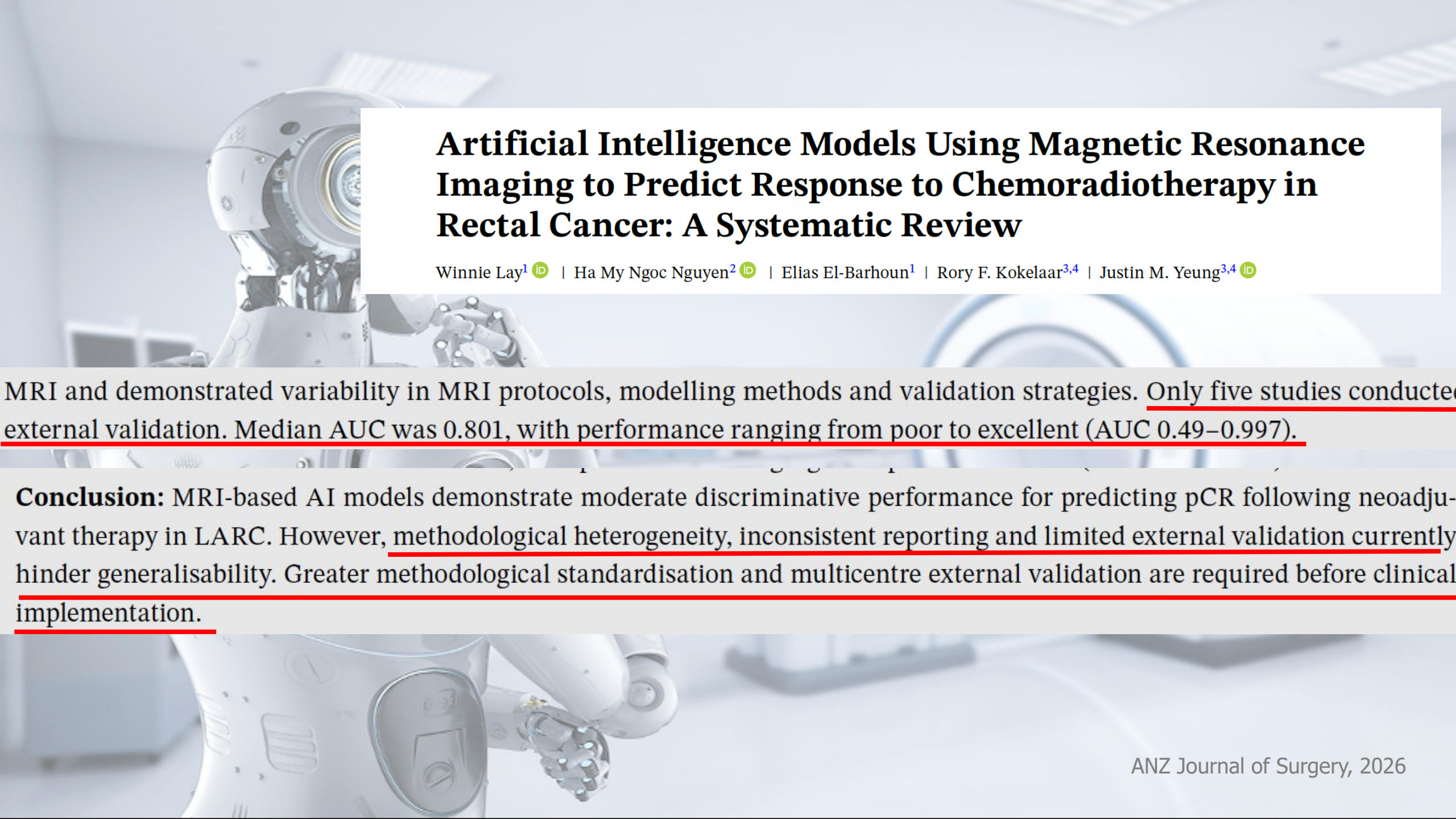
Diagnostic Imaging in Oncology | Published: 21 March 2024

Deep learning algorithms for predicting pathological complete response in MRI of rectal cancer patients undergoing neoadjuvant chemoradiotherapy: a systematic review

Results Out of 512 initial records, 26 studies met the inclusion criteria. Most studies demonstrated promising diagnostic performance, with AUC values for external validation typically exceeding 0.8. The use of T2W and diffusion-weighted imaging (DWI) MRI phases enhanced model accuracy compared to T2W alone. Larger datasets generally correlated with improved model performance. However, heterogeneity in model designs, MRI protocols, and the limited integration of clinical data were noted as challenges.

Conclusion AI-enhanced MRI demonstrates significant potential in predicting pCR in rectal cancer, particularly with T2W + DWI sequences and larger datasets. While integrating clinical data remains controversial, standardizing methodologies and expanding datasets will further enhance model robustness and clinical utility.

Jong et al, Int J Colorectal Dis 2025



Artificial Intelligence Models Using Magnetic Resonance Imaging to Predict Response to Chemoradiotherapy in Rectal Cancer: A Systematic Review

Winnie Lay[1] | Ha My Ngoc Nguyen[2] | Elias El-Barhoun[1] | Rory F. Kokelaar[3,4] | Justin M. Yeung[3,4]

MRI and demonstrated variability in MRI protocols, modelling methods and validation strategies. Only five studies conducte external validation. Median AUC was 0.801, with performance ranging from poor to excellent (AUC 0.49–0.997).

Conclusion: MRI-based AI models demonstrate moderate discriminative performance for predicting pCR following neoadjuvant therapy in LARC. However, methodological heterogeneity, inconsistent reporting and limited external validation currently hinder generalisability. Greater methodological standardisation and multicentre external validation are required before clinical implementation.

ANZ Journal of Surgery, 2026

Review

Artificial intelligence in the care of patients with rectal cancer undergoing neoadjuvant chemoradiation and intentional watchful waiting: a literature review

Boyang Qu, Aiwen Wu*

AUC of AI	pCR	pN+	Loc Regrowth & M+
Endoscopy	**0.80**		
DWI MRI	**0.80**	**0.80**	
Longitudinal DWI MRI	**0.90**		
Multimodal MRI/pathology	**0.80**		
Multimodal MRI/pathol/surgery			**0.90**
Multimodal MRI/clinical	**0.80**		**0.80**
EUS	**0.76**		

Intel. Med 2025

Flagship project Europe's Beating Cancer Plan

Federated infrastructure with cancer images to accelerate development & validation of AI solutions

EUROPEAN INSTITUTE FOR BIOMEDICAL IMAGING RESEARCH

AI deployment in EU healthcare

2015-23: 25x increase in FDA-approved AI-tools n=221

Only 5% of hospitals have deployed AI tools

AI deployment in healthcare is a present demand
....the gap is deployment at scale

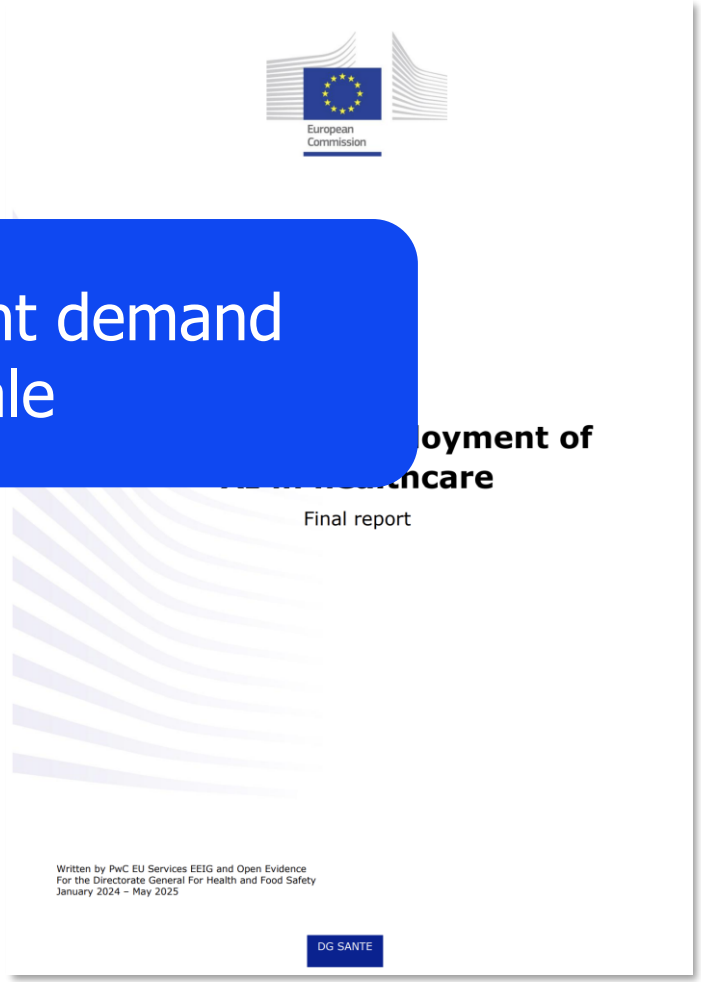
Barriers

Technologica

Legal **complex regulations,** privacy concerns

Organisational **lack of strategic directions**, resources,
no end-user involvement

Culture job security fears, **trust issues**,
low AI literacy



What would make AI work in hospitals ?

Medical professionals will not likely adopt algorithms but adopt **new ways of working –** *does it help me to give better care?*

Real-world validation - Local performance testing

Does AI tool work as well in our center and with our patients?

AI fully embedded in clinical workflow & clinical decision pathways

If AI is not inside the workflow - it is not inside care

AI deployment is committing to lifelong monitoring

Strong Clinical AI leadership

data governance board/multidisciplinary implementation team

Compliance to regulations must be part of routine patient safety and quality

Human oversight

- Who is responsible?
- When do doctors intervene?
- Post-deployment – continuous safety monitoring, validation of updates, evaluation impact on clinical outcomes

AI deployment is workforce transformation

New Hybrid Roles

- *Physician AI champions*
- *Clinical data scientists*
- AI-literate nurses & allied professionals

AI literacy training for medical professionals

- Understanding risks, bias, limitations

EU's Apply AI Strategy

Compass AI

flagship initiative

European Network of Expertise on AI Deployment in Healthcare to consolidate guidelines and best practices

European Commission

EN

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NEWS ARTICLE | Publication 21 October 2025

Commission launches flagship initiative to increase use of AI in healthcare

The Commission has launched COMPASS-AI – a new initiative that includes the establishment of a community of experts to advance the safe and effective use of artificial intelligence (AI) in healthcare.

This is one of the flagship measures in the Commission's recent Apply AI Strategy. The initiative will work to promote the responsible and effective integration of AI into clinical settings.

It will focus, in particular, on two priority areas: cancer care and healthcare in remote areas. Supported by partners with extensive networks across hospitals, professional societies and EU AI-healthcare projects, the initiative will also launch an interactive digital platform to map best practices and facilitate knowledge exchange. The network will deliver AI deployment guidelines and work to raise AI literacy of healthcare professionals, hospital managers and patients.

Commissioner for Health and Animal Welfare, Olivér **Várhelyi**, said:

> AI has the potential to transform healthcare by advancing precision medicine through enhancing prevention, speeding up clinical trials, improving diagnostic accuracy, optimising treatment decision-making and by streamlining workflows. It can also enable more personalised care, improving health outcomes for Europeans. To fully realise these benefits, we must ensure broader uptake and integration of trustworthy AI solutions across healthcare systems. Building on key European Commission priorities such the European Health Data Space, COMPASS-AI will advance health innovation and promote the adoption of AI in healthcare across Europe. For this purpose, the upcoming Biotech Act at the end of this year, that focuses primarily on health, will be instrumental.

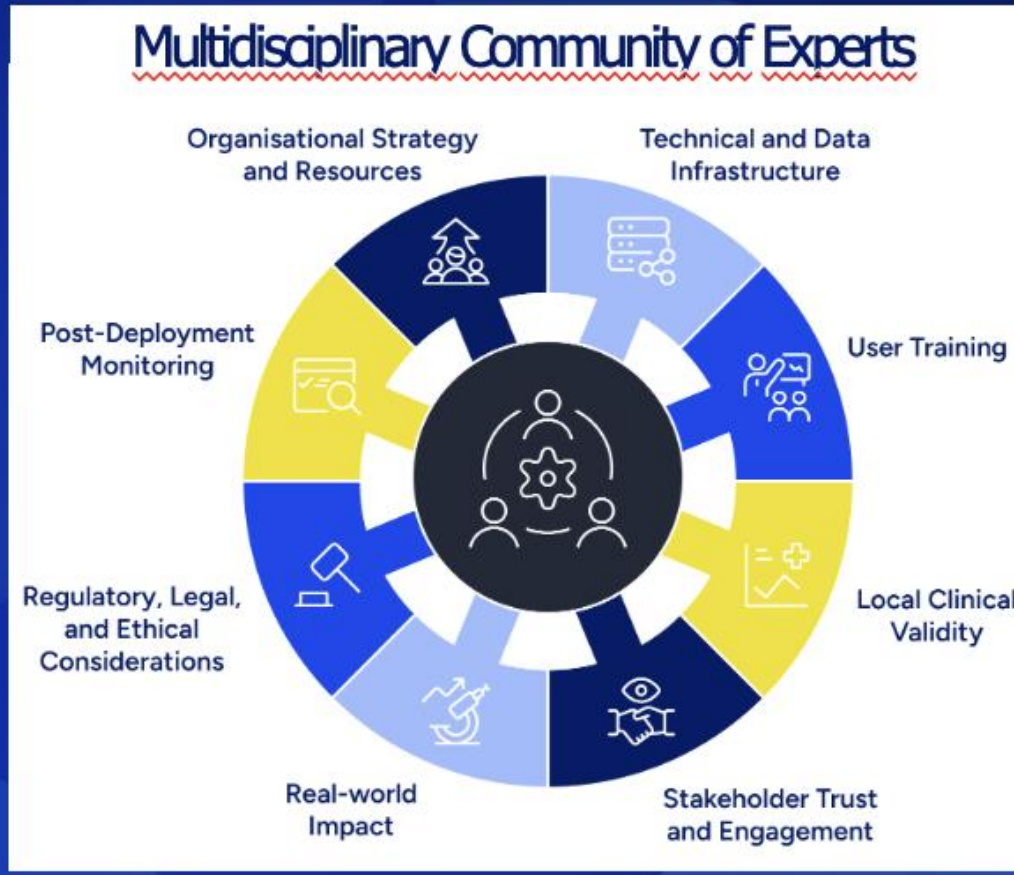
AdobeStock © chiew

Related topics

Artificial intelligence | AI in health

Compass AI

Advancing AI Adoption in European Healthcare



Prof. Dr. Regina Beets-Tan, Maastro/Maastricht University
Dr. Laurens Topff, Netherlands Cancer Institute (NKI)

Consortium partners: UM, NKI, EIBIR, HULAFE, UMCU, OVGU, UB, EATRIS, IPATIMUP, FPG, QUIBIM, BSC

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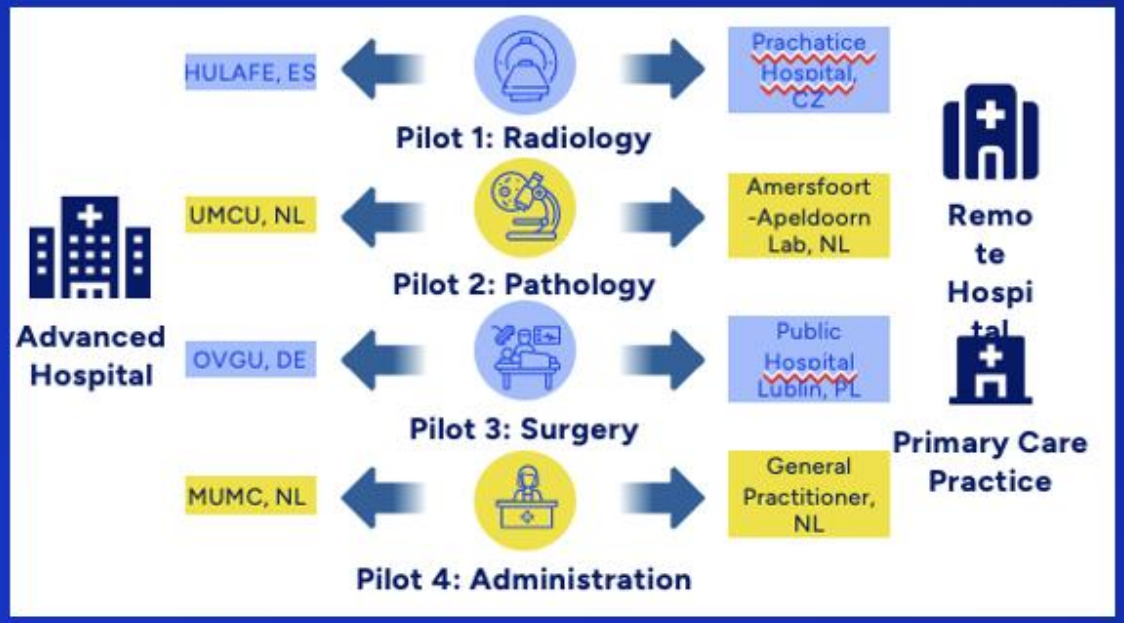
Co-funded by the European Union

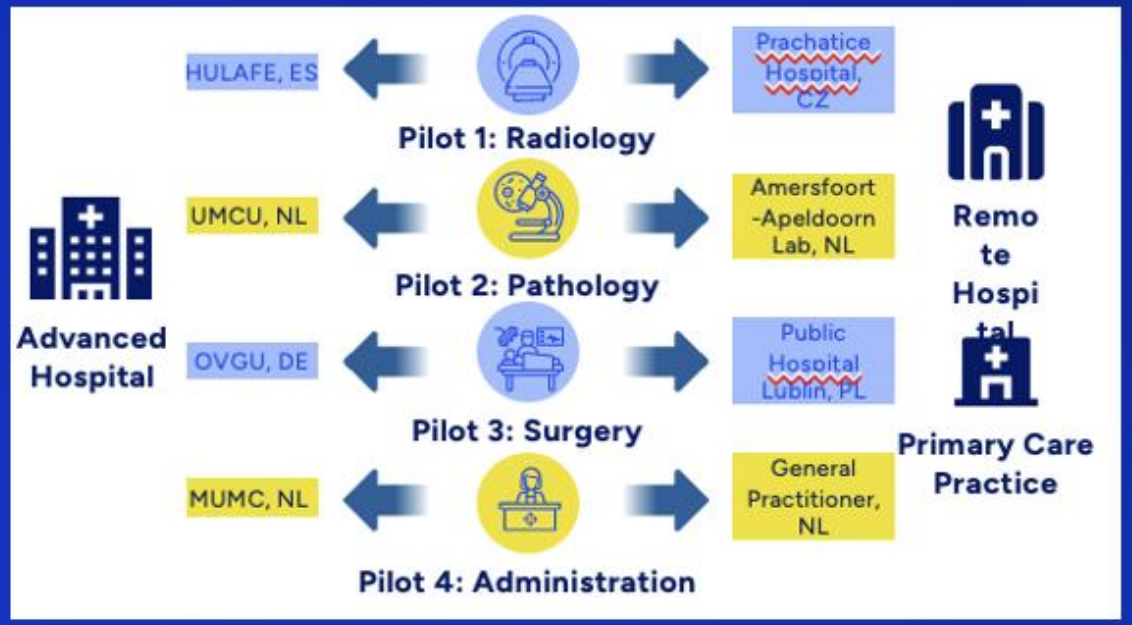
Compass AI what it will deliver...

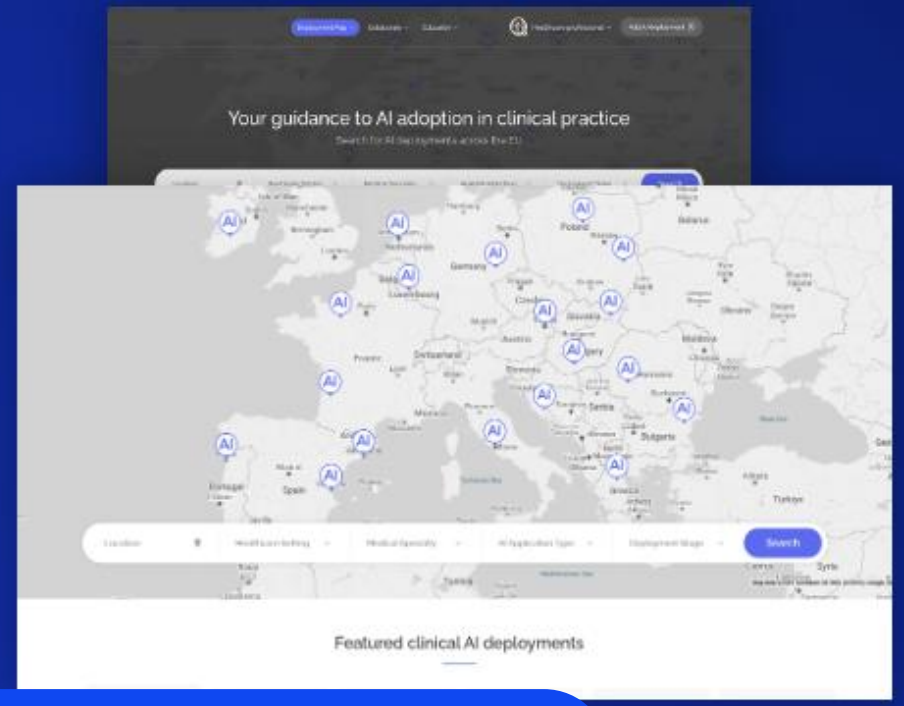


- **Practical step-by-step AI deployment guidelines**

Co-funded by the European Union

Compass AI what it will deliver...





Prepare the European Healthcare systems for full scale deployment of AI

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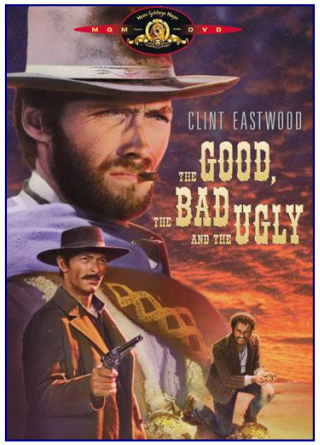
Take Home Message



RECTAL CANCER – Paradigm Shifts

- **Radiology has become more Predictive & Prognostic**
- Treatment shifts towards more **Organ Preservation**

ORGAN PRESERVATION

- **Secondary** non intended → LARC up to 30-40% organ preservation
- **Primary** intended → smaller and earlier stage up to 60-80% organ preservation

Take Home Message

FUTURE - MORE ORGAN PRESERVATION

- **Combination treatment to increase cCR**

  ICI for dMMR rectal ca → 100% organ preservation

  adding ICI to RT for pMMR rectal ca → potentially 60% organ preservation

- **Improve non-invasive methods for response evaluation**

  multimodal AI predictive model of outcome

  (integrating imaging, tissue, molecular, blood, clinical biomarkers)

JSRS 2026

Thank You

Second-opinion reviews improve MR report completeness & changes in surgical planning

- 461 rectal MRI reports submitted for second-opinion (2014 – 2020)
- **54% (248/461) showed discordance, with 56% (140/248) classified as major discordance**

- 2 **CRC surgeons**, blinded to report origins, **reviewed cases with major discordance** to evaluate their theoretical impact on patient management and rated their confidence level of reports
  - **second reviews led to changes in surgical planning in 40%**

Gollub et al, Eur Rad 2025