APPROPRIATEZZA DELL'IMAGING NEI TUMORI DELL'ESOFAGO

Appropriatezza nella Radiologia Avanzata e prospettive future nei Tumori dell'Esofago

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Chieti

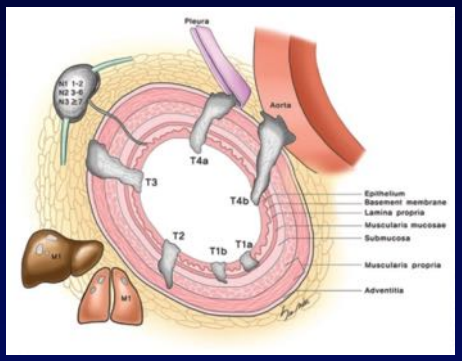
Oesophageal carcinoma

Complementary role of multimodality imaging in the management of patients

Central role of radiology in the era of «Clinical decision making»

Structured report for staging and restaging oesophageal cancer

Invasive Oesophageal carcinoma



Outcome predictors and Aims of Staging

- *Parietal Invasion (T stage)*
- *Lymphatic Invasion (N stage)*
  - *Regional vs Distant lymph nodes*
- *Metastatic Disease (M stage)*
- *Vascular Invasion*
- *Operative margin involvement (CRM)*

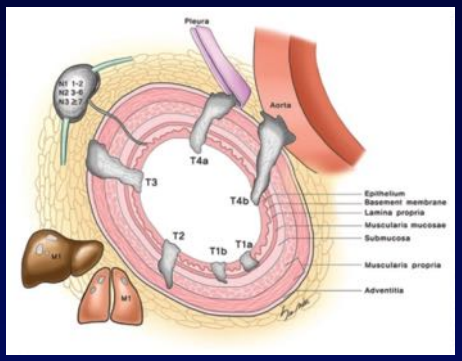
Surgery

Neoadjuvant therapies

Palliative treatment

Endoscopic therapies

Oesophageal carcinoma



Optimising pre-treatment staging allows correct patient management algorithm

Oesophageal carcinoma

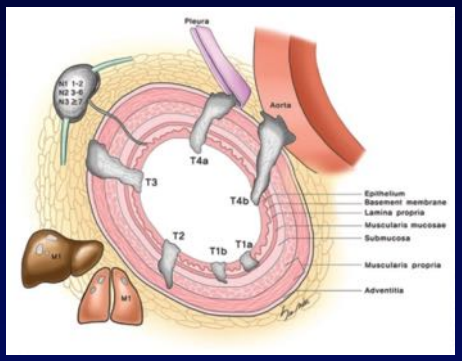
Multiple imaging modalities

MDCT

Primary staging investigation

✓ *First musketeer*

Oesophageal carcinoma



MDCT

- *Key objectives*

✓ *Define tumour position/extent/length*
  - Circumferential Resection Margin

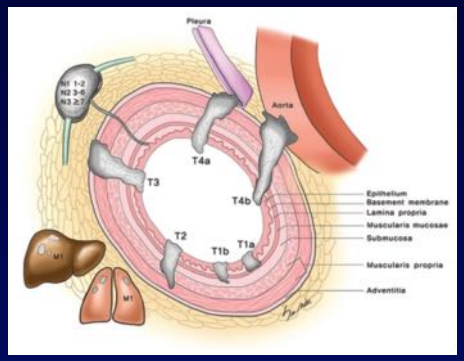
✓ *Identify local invasion /lymph node enlargement*

✓ *Identify metastatic spread*

✓ *Determine the degree of oesophageal obstruction and associated complications*

✓ *Evaluate treatment response «Downstaging»*

Oesophageal carcinoma

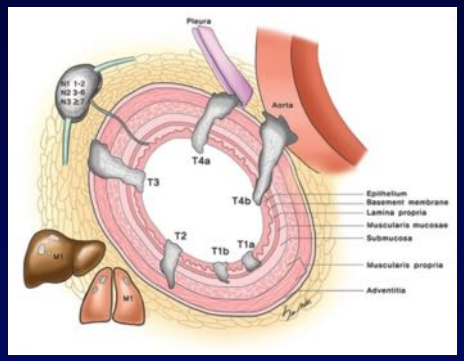


MDCT Structured Report

- *Primary tumour*

- *Annular/Semi-annular/Polypoidal/Ulcerating*
- *Total cranio-caudal length tumour ( ) mm*
- *Tumour position: Upper/Mid/Lower S1/S2/S3 Junctional T*
- *Maximal tumour thickness ( ) mm*
- *Extramural spread Yes/No Depth ( ) mm*
- *Nearest CRM is…..*

Oesophageal carcinoma

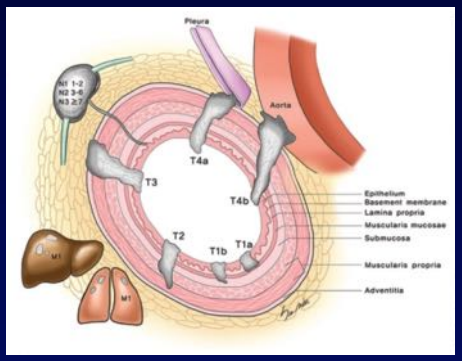


MDCT Structured Report

- Involved regional lymph nodes
  - *Peri-oesophageal* *Yes/No* *Number ( )*
  - *Mediastinal* *Yes/No* *Number ( )*
  - *Left gastric* *Yes/No* *Number ( )*
  - *Celiac axis* *Yes/No* *Number ( )*
- Involved non regional lymph nodes *Yes/No* *Location*

(outside surgical field from cervical perioesophageal to celiac nodes)

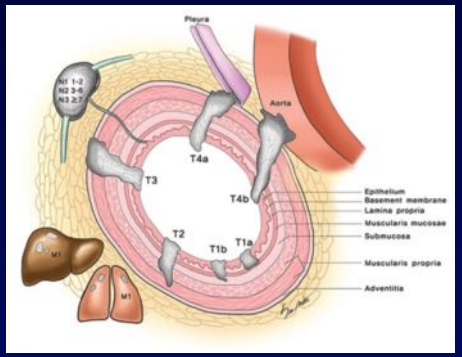
Oesophageal carcinoma



MDCT Structured Report

- *Peritoneal involvement* *Yes/No*
- *Liver Metastases* *Yes/No*
- *Pulmonary Metastases* *Yes/No*

Oesophageal carcinoma

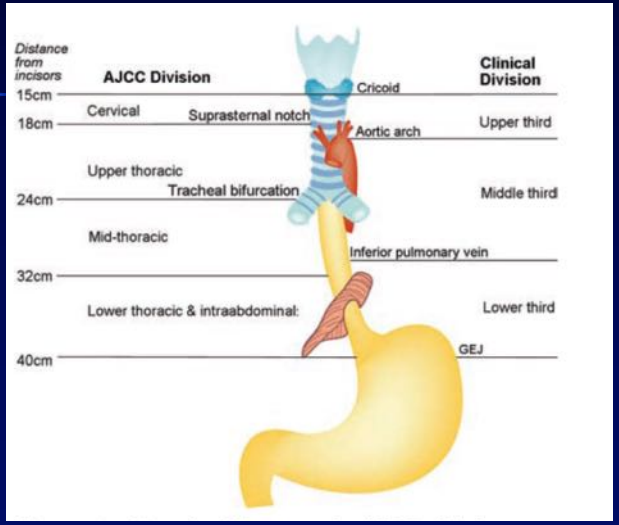


MDCT Structured Report

Conclusion *T ( ) N ( ) M ( )*

- *Position* *Upper/Mid/Lower*
- *Potential CRM* *Safe/at risk*

Oesophageal carcinoma



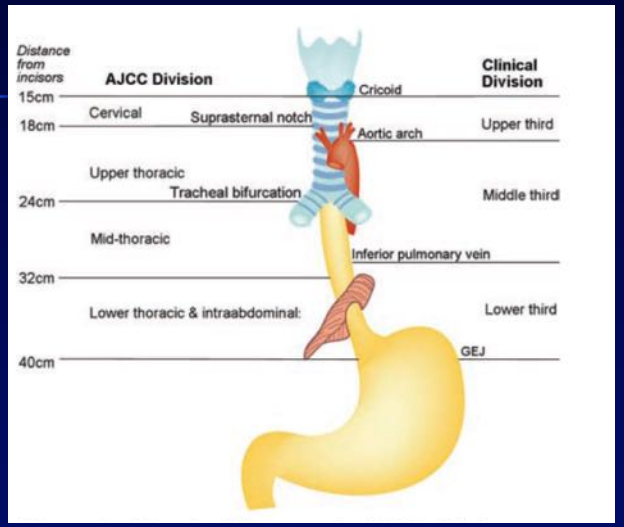
Tumor location

1) *Cervical*
2) *Thoracic*
   - *Upper*
   - *Middle*
   - *Lower*
3) *Abdominal*

Location is defined by upper extent tumour

- Involving GOJ: Junctional tumours

Oesophageal carcinoma



Tumor location

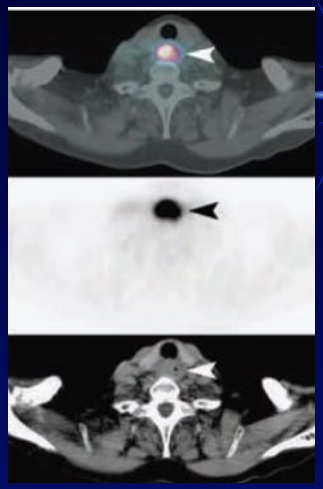
Location of primary tumour does not necessarily affect prognosis

BUT

Determines subsequent treatment regime

Junctional tumours

↪ Laparoscopy for staging



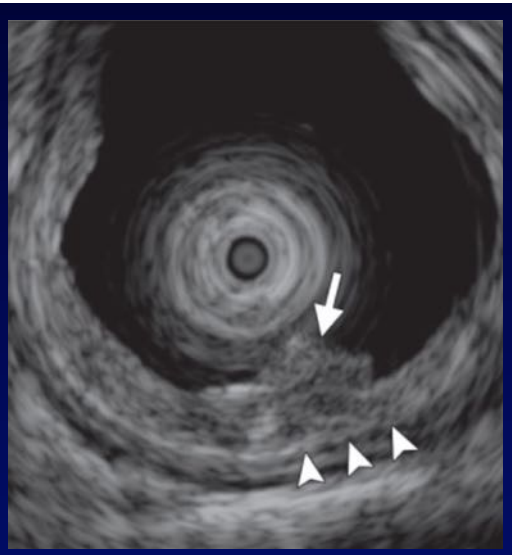
Oesophageal carcinoma

Multiple imaging modalities

PET/CT

✓ *Second musketeer*

Detects unexepected metastases in 5-28% of patients (bone metastases, lymph nodes etc)



Oesophageal carcinoma

Multiple imaging modalities

EUS

✓ *Third musketeer*

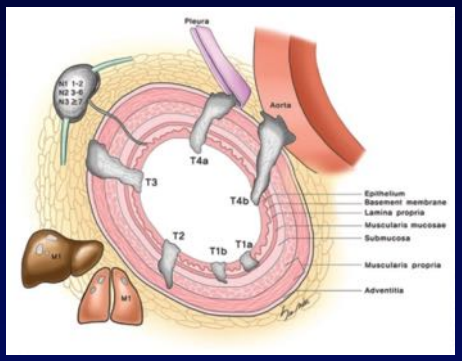
Guidelines suggest mandatory for local staging in the non metastatic patients

Problem solving tool

resectable tumour: what about lymp nodes detected by CT?

Junctional tumours: extension to crura

Oesophageal carcinoma

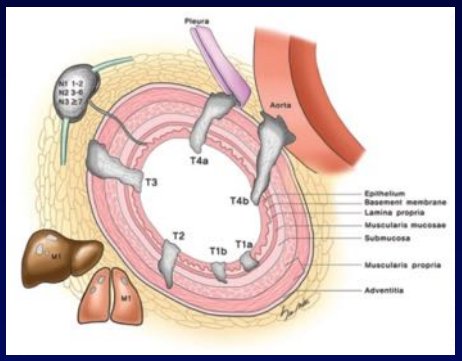


MULTIMODALITY IMAGING ALGORITHM

➢ *MDCT*

- *First line staging modality*
- *Advanced loco-regional disease and/or metastatic disease*
  - *No further investigations*
- *Assessment disease response neo-adjuvant treatment*

Oesophageal carcinoma

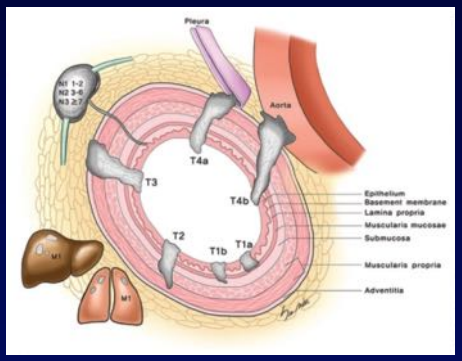


MULTIMODALITY IMAGING ALGORITHM

- ***EUS***

- *Local staging*
- *Pragmatic problem solving: T1a vs T1b/T3vs T4a/b*

Oesophageal carcinoma

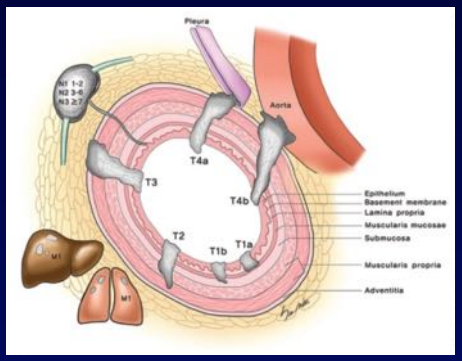


MULTIMODALITY IMAGING ALGORITHM

- ***PET/CT***

- *Initial staging in potentially resectable patients*
- *Assessment of treatment response*
- *Detection of recurrent disease*

Oesophageal carcinoma



M

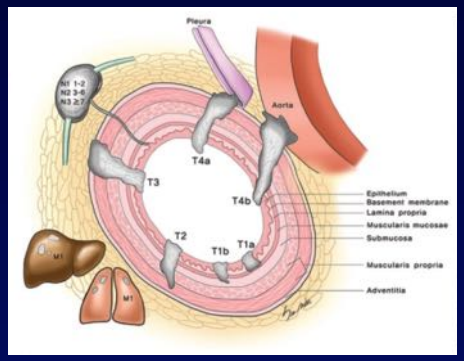
- *T*
- *T*

Multidisciplinary team management is critical to optimal patient outcome

em

bronchus

Oesophageal carcinoma



What about the Future?

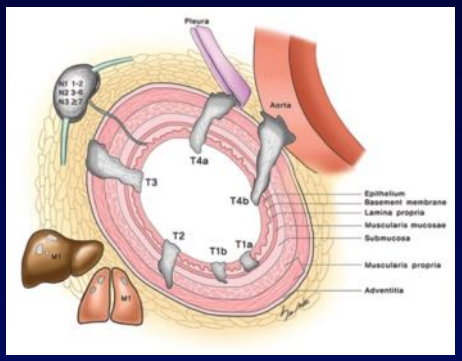
➢ *Pre-Treatment*

- *DWI*
- *Tensor MRI*
- *PET/MRI*

➢ *Post-Treatment*

- *DWI*
- *Perfusion CT*

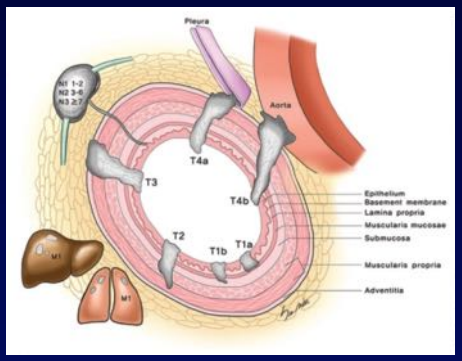
Oesophageal carcinoma



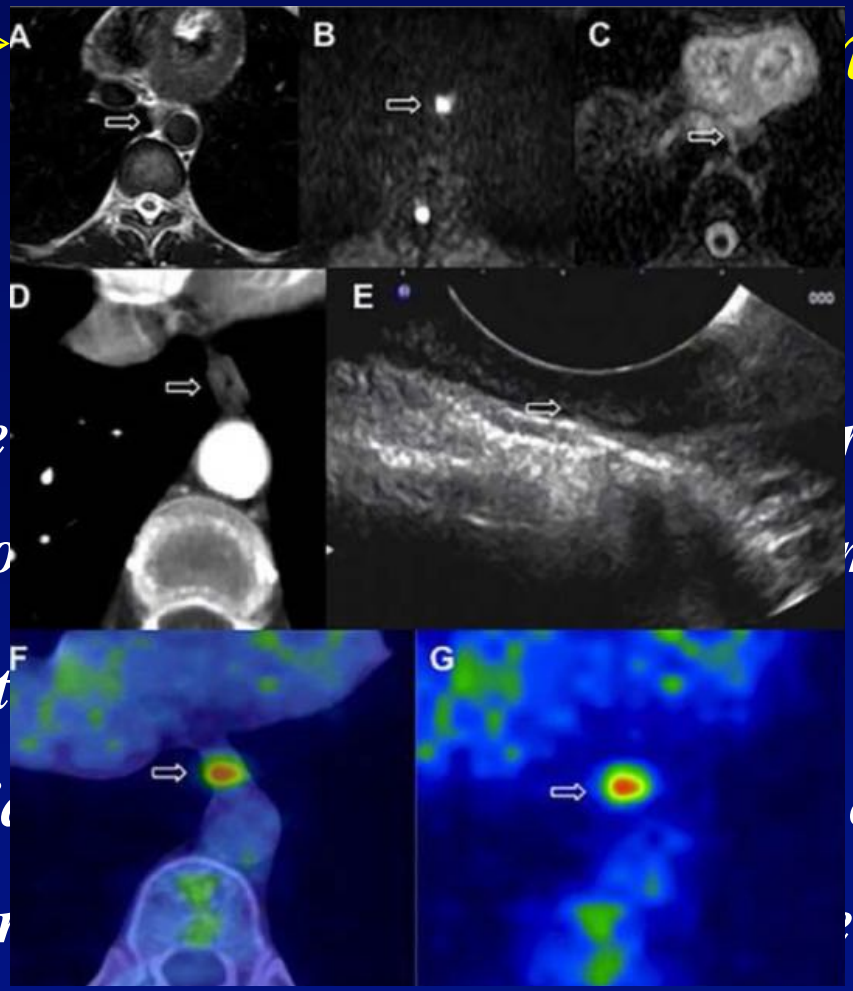
➢ *Pre-Operative staging*

- Br J Radiol. 2016 Dec;89(1068):20160087. Epub 2016 Oct 21.
- **Prospective comparison of MR with diffusion-weighted imaging, endoscopic ultrasound, MDCT and positron emission tomography-CT in the pre-operative staging of oesophageal cancer: results from a pilot study.**
- Giganti F[1,2], Ambrosi A[2], Petrone MC[3], Canevari C[4], Chiari D[2,5], Salerno A[1,2], Arcidiacono PG[3], Nicoletti R[1], Albarello L[6], Mazza E[7], Gallivanone F[8], Gianolli L[4], Orsenigo E[5], Esposito A[1,2], Staudacher C[2,5], Del Maschio A[1,2], De Cobelli F[1,2]

Oesophageal carcinoma



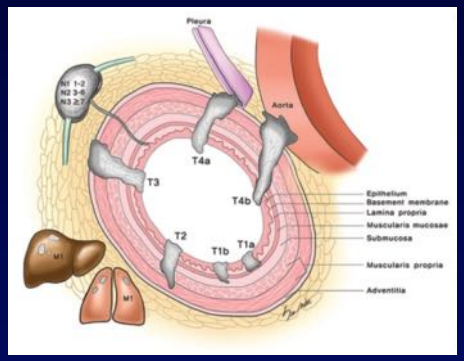
➢ *ng*



EUS *Highe ng ⟶ primary role fo mours*

MR *Highest (83%) for T staging ⟶ potenti organ-confined tumours where r es were not satisfactory*

Oesophageal carcinoma



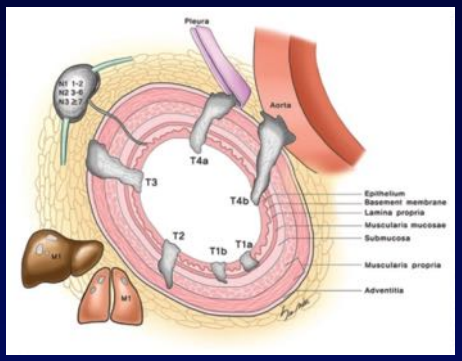
- ***Pre-Operative staging***
  18 pts

N staging

MR and EUS

Higher sensitivity than MDCT but none of the three techniques had satisfactory results in terms of specificity and accuracy

Oesophageal carcinoma



➢ *Pre-Operative staging*

M

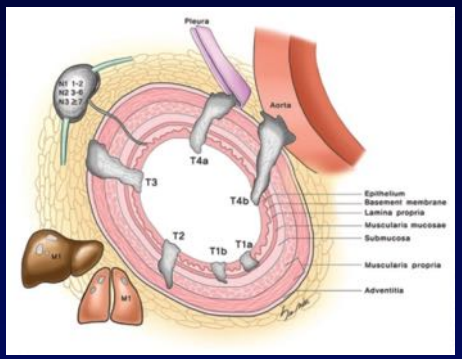
Hi *es*

ha

CONCLUSION:

In this pilot study, we have shown that MR with DWI could enrich the current pre-operative work-up for oesophageal cancer and could be used for T and N staging. However, larger studies will need to be carried out before introducing this technique in the standard diagnostic pathway, in order to understand if MR with DWI could change its management and replace more costly or invasive tests such as PET-CT or EUS

Oesophageal carcinoma



➢ *Pre-treatment staging*

Esophageal Carcinoma: Ex Vivo Evaluation with Diffusion-Tensor MR Imaging and Tractography at 7 T[1]

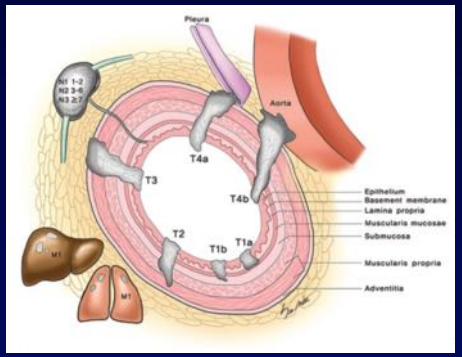
Purpose: To determine the feasibility of diffusion-tensor magnetic resonance (MR) imaging and tractography as a means of evaluating the depth of mural invasion by esophageal carcinomas.

Results: In all 20 carcinomas (100%), the diffusion-weighted images, apparent diffusion coefficient (ADC) maps, fractional anisotropy (FA) maps, λ_1 maps, and direction-encoded color FA maps made it possible to determine the depth of tumor invasion of the esophageal wall that was observed during histopathologic examination. The λ_1 maps showed the best contrast between the carcinomas and the layers of the esophageal wall. The carcinomas had both lower ADC values and lower FA values than the normal esophageal wall; thus, the carcinomas were clearly demarcated from the normal esophageal wall. Diffusion-tensor tractography images were also useful for determining the depth of tumor invasion of the esophageal wall.

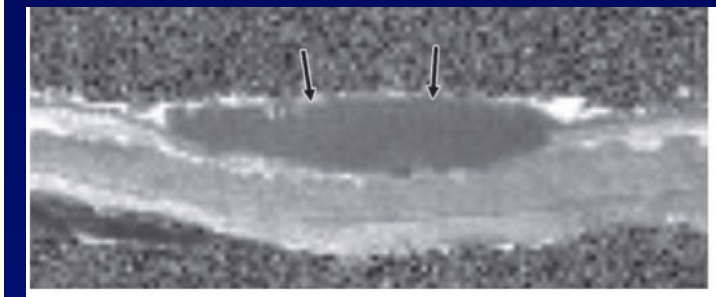
Conclusion: Diffusion-tensor MR imaging and tractography are feasible in esophageal specimens and provide excellent morphologic data for the evaluation of mural invasion by esophageal carcinomas.

▪ ***Radiology:*** Volume 272: Number 1—July 2014

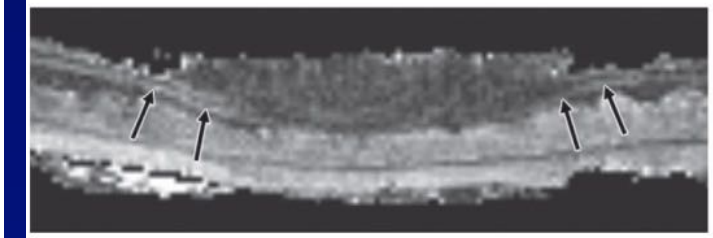
Oesophageal carcinoma



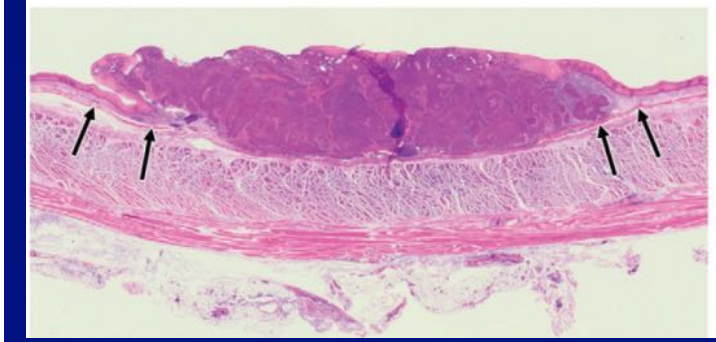
➢ *Pre-treatment staging*

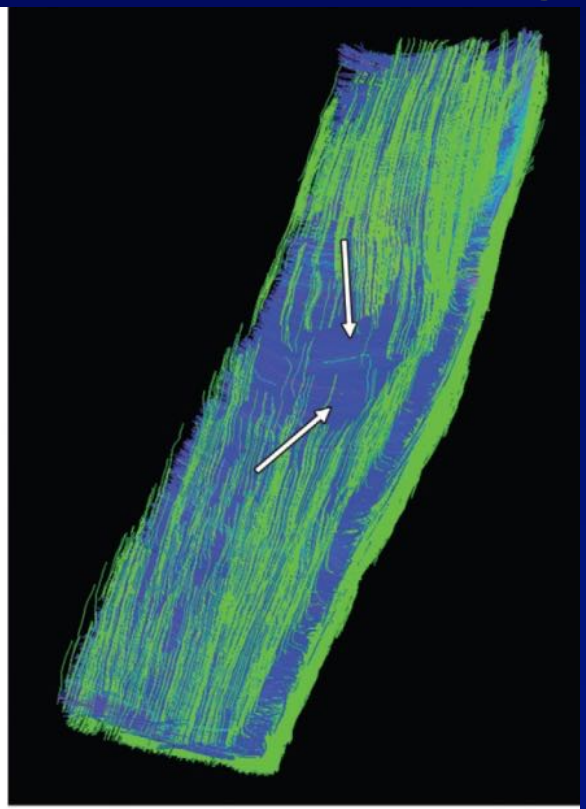


a.



b.





c.

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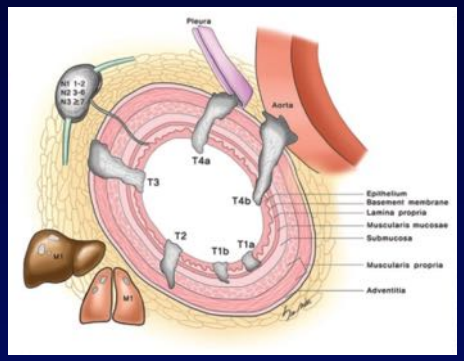
Oesophageal carcinoma



➢ *Pre-treatment staging*

Clinical Implication of PET/MR Imaging in Preoperative Esophageal Cancer Staging: Comparison with PET/CT, Endoscopic Ultrasonography, and CT

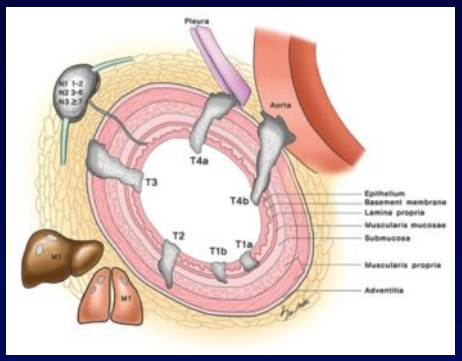
Geewon Lee*[1,2], Hoseok I*[2,3], Seong-Jang Kim[2,4], Yeon Joo Jeong[1,2], In Joo Kim[2,5], Kyoungjune Pak[2,4], Do Yun Park[2,6], and Gwang Ha Kim[2,5]

J Nucl Med 2014; 55:1242–1247
DOI: 10.2967/jnumed.114.138974

19 patients

Identification of oesophageal wall layers

Oesophageal carcinoma



➢ Pre-treatment staging

TABLE 4
Diagnostic Accuracy for Primary Tumor Staging

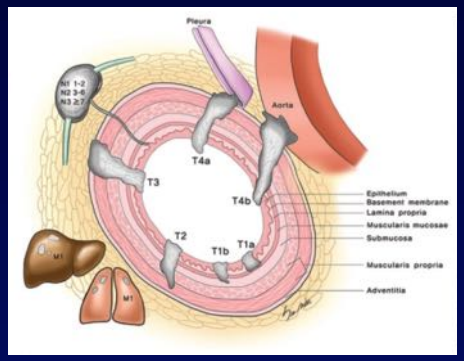
	Accuracy			*P*		
Stage	EUS	CT	PET/MR imaging	EUS vs. CT	EUS vs. PET/MR imaging	CT vs. PET/MR imaging
Total	86.7	33.3	66.7	0.021	0.375	0.063
T1	86.7	46.7	80.0	0.070	>0.990	0.063
T2	86.7	53.3	73.3	0.125	0.625	0.250
T3	93.3	86.7	86.7	0.500	0.500	>0.990

PET-MR demonstrated acceptable accuracy for T staging, compared with EUS and, although not statistically significant, even higher accuracy than EUS and PET-CT for prediction of N staging

N staging *PET-MR 83,3%, EUS 75%, PET-CT 66,7%,*

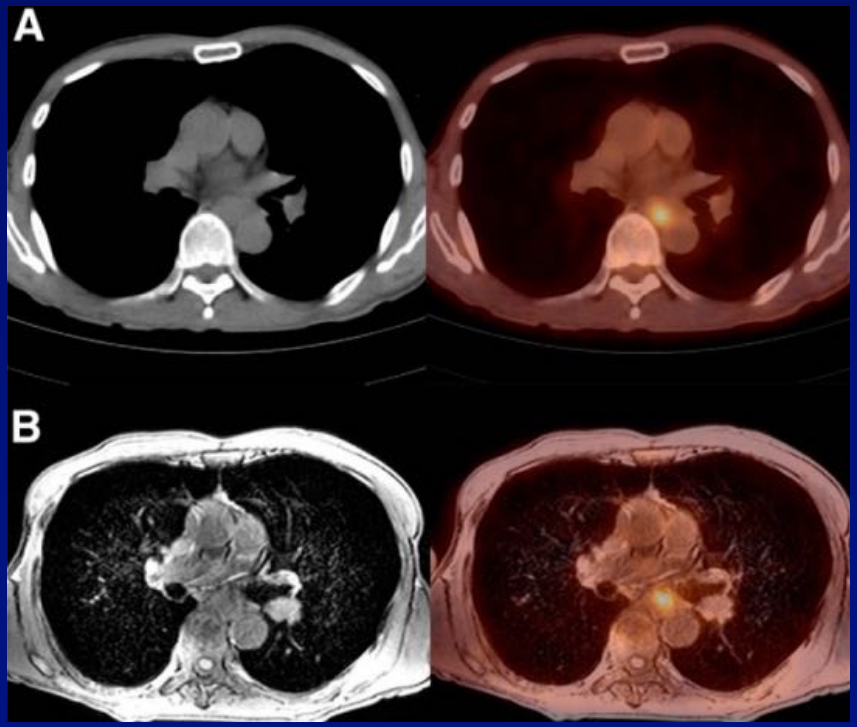
MDCT 50%

Oesophageal carcinoma



- ***Pre-treatment staging***

PET-MR

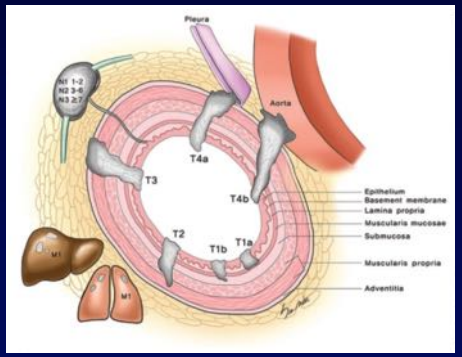


Limits

Adjustments in protocols

Low machines availability

Oesophageal carcinoma



➢ *Post treatment restaging*

Radiotherapy and Oncology 115 (2015) 163–170

Contents lists available at ScienceDirect

Radiotherapy and Oncology

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MRI in esophageal cancer

Diffusion-weighted magnetic resonance imaging for the prediction of pathologic response to neoadjuvant chemoradiotherapy in esophageal cancer ☆

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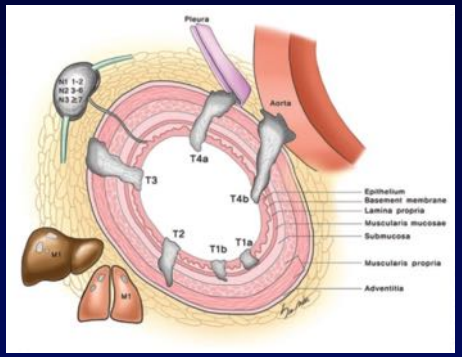
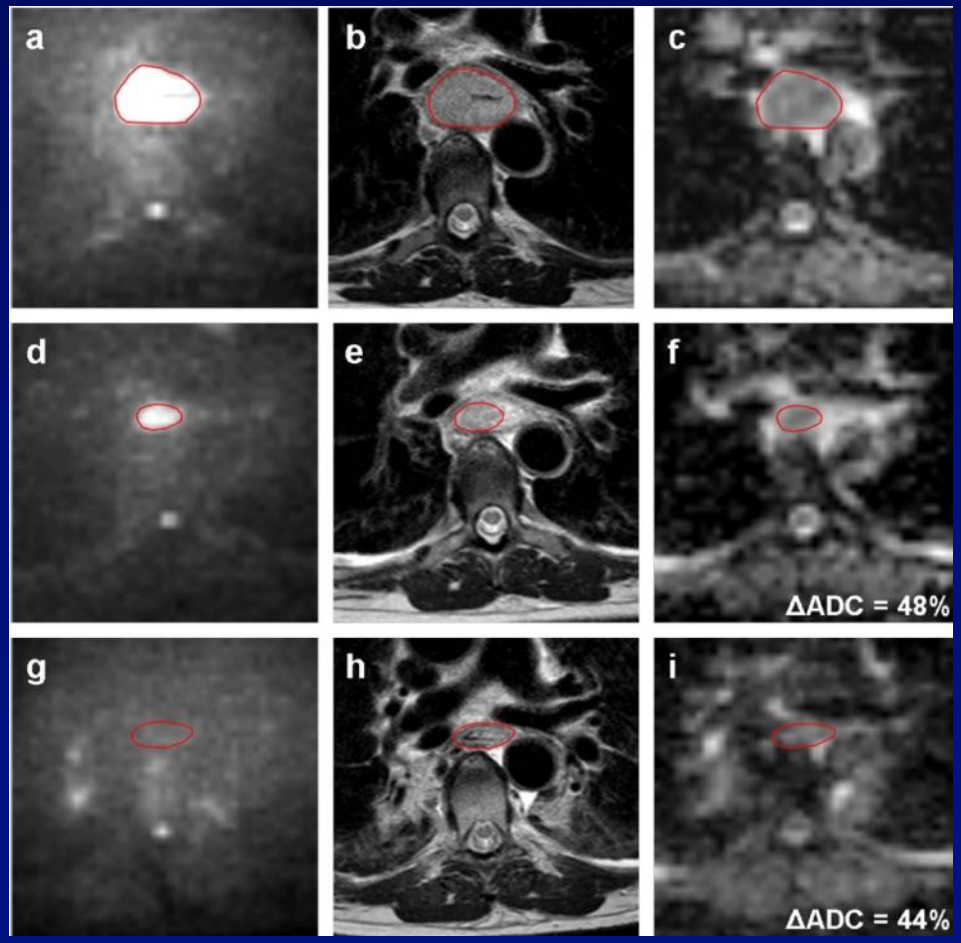
Oesophageal carcinoma



➢ *Post treatment restaging*

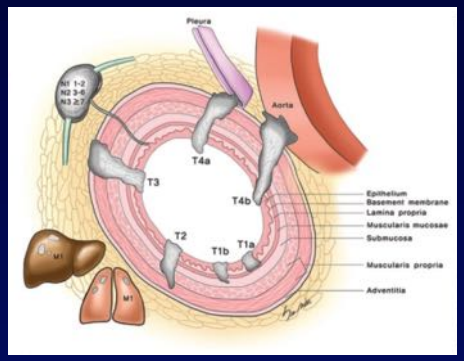


Before nCRT

During nCRT

After nCRT

Oesophageal carcinoma



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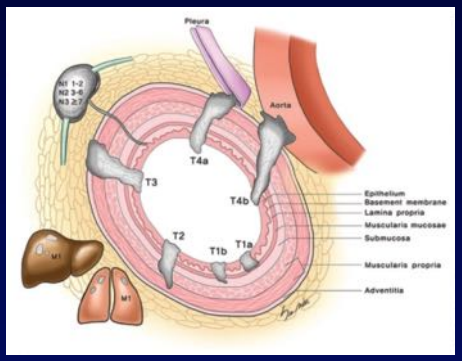
- ✓ *Pathological CR or good response status could be predicted by the change in tumour ADC early during neoadjuvant treatment (as in rectal, brain cancer etc)*
- ✓ *Early ADC changes (two to three w) during nCRT are more predictive of pathCR than late ADC changes after completion of nCRT*

Oesophageal carcinoma



➢ Post treatment restaging

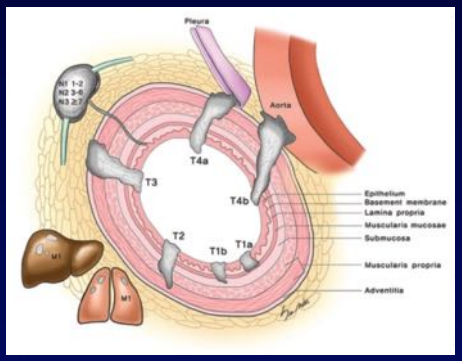
DWI

- ✓ *No significant association between initial ADC and response*
- ✓ *Significant association between higher initial ADC values in non responders ⟶ presence of necrotic areas which are less responsive to cytotoxic treatments*

Van Rossum P et al Radiotherapy and Oncology 2015

De Cobelli F et Eur Radiol 2013

Oesophageal carcinoma



Eur Radiol. 2013 Sep;23(9):2492-502. doi: 10.1007/s00330-013-2844-8. Epub 2013 May 4.

Accuracy of multidetector-row CT for restaging after neoadjuvant treatment in patients with oesophageal cancer.

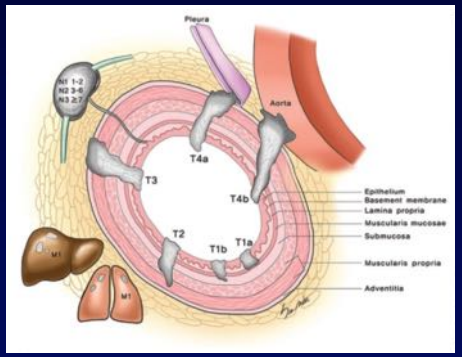
Konieczny A[1], Meyer P, Schnider A, Komminoth P, Schmid M, Lombriser N, Weishaupt D.

Exclude disease progression

CONCLUSION:

Although MDCT tends to be able to exclude advanced tumour stages (T3, T4) with a higher likelihood, the diagnostic accuracy of high resolution MDCT for restaging oesophageal cancer and assessing the response to neoadjuvant therapy has not improved in comparison to older-generation CT. Therefore, the future assessment of oesophageal tumour response should focus on combined morphologic and metabolic imaging.

Oesophageal carcinoma



➢ *Post treatment restaging*

Perfusion CT

European Journal of Radiology 84 (2015) 2477–2484

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journal homepage: www.elsevier.com/locate/ejrad

Absolute CT perfusion parameter values after the neoadjuvant chemoradiotherapy of the squamous cell esophageal carcinoma correlate with the histopathologic tumor regression grade

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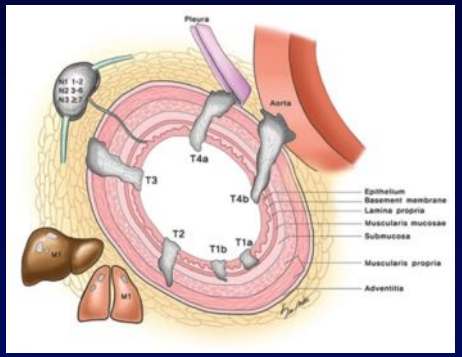
[e] First Surgery University Clinic, Clinical Center of Serbia, Belgrade, Serbia

✓ *Blood flow blood volume MTT significantly correlated with the tumor regression grade → to incorporate lowdose CTp study into regular CT examination protocol due to restaging purposes*

Oesophageal carcinoma



Imaging Appropriateness

NCCN National Comprehensive Cancer Network®

	Clinical Setting	Guideline Page	Category of Evidence	Stage	Indication	Imaging Recommendation	Purpose	Imaging Notes
	Esophageal and Esophagogastric Junction Cancers	ESOPH-1	2°		Initial workup	•Chest/Abdominal CT with oral contrast and IV contrast •Pelvic CT with contrast as clinically indicated •If no evidence of M1 disease:PET/CT •Endoscopic ultrasound	Diagnostic/Staging	EUS if no evidence of M1 disease. EUS performed prior to any treatment is important in the initial clinical staging of neoplastic disease. PET/CT if no evidence of M1 disease. Review CT and PET scans prior to EUS to become familiar with nodal distribution for possible fine-needle aspiration (FNA) biopsy.