XXV CONGRÉS

Societat Catalano-Balear de Cirurgia Maxil·lofacial i Oral

Advances in oral and oropharyngeal cancer treatment

Quina és la millor prova d'imatge per estadificar el carcinoma escatós de cap i coll: PET-TC? (T amb afectació òssia, No vs N+, M0 vs M1, valoració de resposta)

Alejandro Fernández León
Medicina Nuclear
Hospital de Sant Pau
Barcelona

XXV CONGRÉS

Societat Catalano-Balear de Cirurgia Maxil·lofacial i Oral

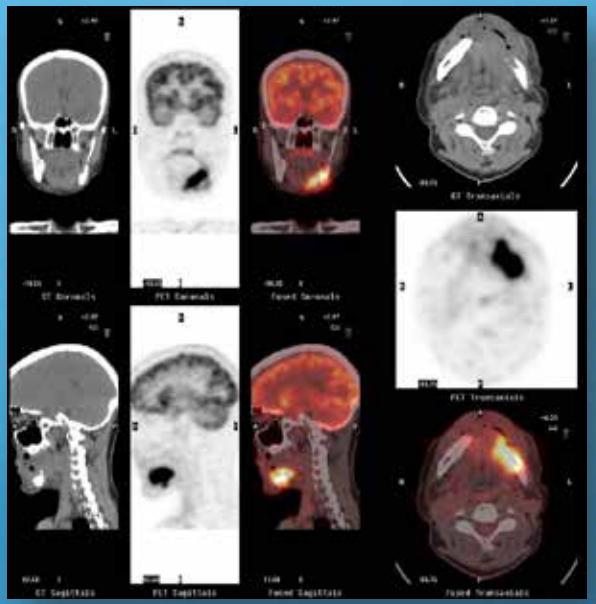
Advances in oral and oropharyngeal cancer treatment

Quin és el millor tractament pel carcinoma escatós de cap i coll: cirurgia, radioteràpia o quimioteràpia?

PET-TC: ¿qué es?

GLUCOSA → Hexoquinasa → GLUCOSA-6P → Glicolisi, Glicogenolisi

18-FDG → Hexoquinasa → 18-FDG-6P → STOP

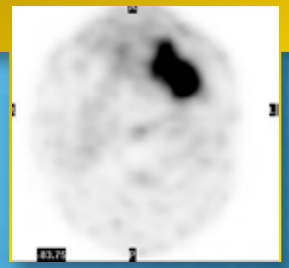


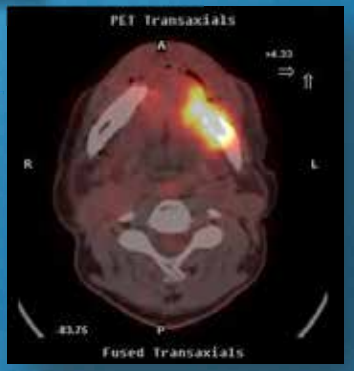
TC

- Información morfológica
- Resolución anatómica
- Limitación por cambios terapéuticos
- Complejidad interpretación estructural

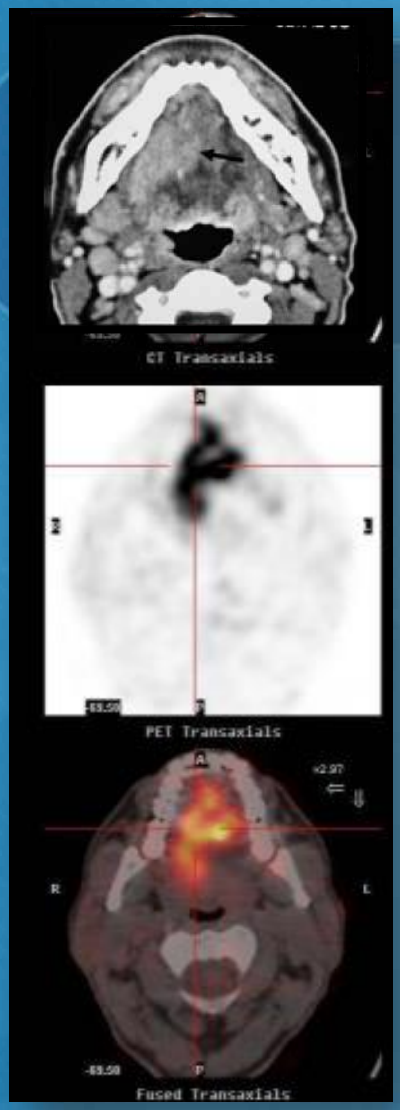
PET

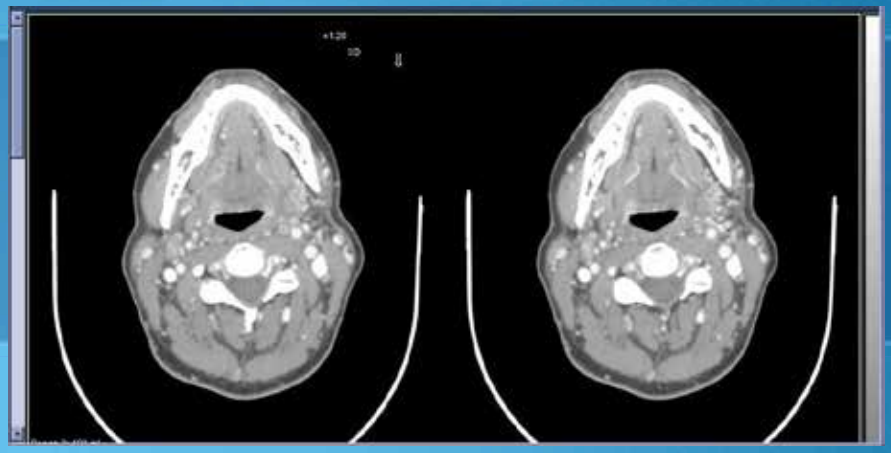
- Información funcional
- Resolución fisiológica
- Limitación por cambios reparadores
- Complejidad interpretación fisiología/inflamación

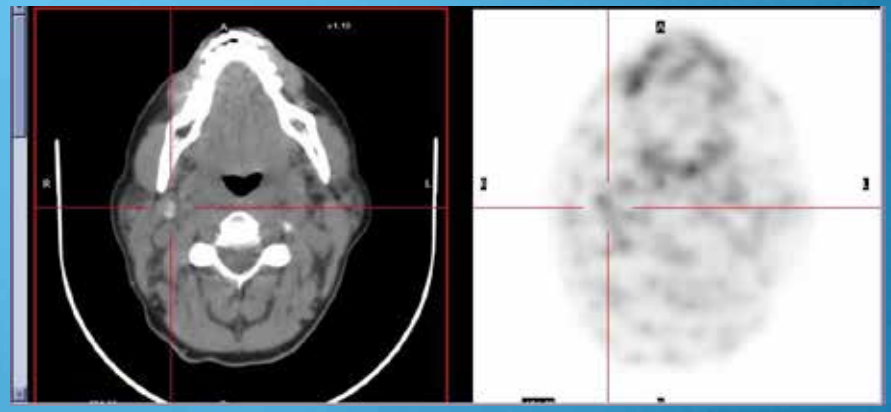




PET-TC con contraste yodado







Q J NUCL MED MOL IMAGING 2011;55:467-99

Role of FDG-PET/CT in staging and follow-up of head and neck squamous cell carcinoma

D. MAK [1], J. CORRY [1], E. LAU [2, 3], D. RISCHIN [4, 5], R. J. HICKS [2, 3, 5]

Subramaniam RM, *Clin Nucl Med*. 2013;38(10):790-794.

¿Hasta qué punto influye la exploración híbrida?

TABLE 1
Clinical Performance of PET/CT: Direct Comparison with PET or CT

Cancer	Study	No. of subjects enrolled	Method with which PET/CT was compared	*P*
Head and neck	Branstetter et al. (*6*), 2005	65	T/N staging by PET	NS
			T/N staging by CT	<0.05
	Schoeder et al. (*7*), 2004	68	Lesion detection by PET	<0.05
	Gordin et al. (*8*), 2006	42	Staging by PET	NS
			Staging by CT	<0.05
	Chen et al. (*10*), 2006	70	Staging by PET	<0.05
			Staging by CT	<0.05

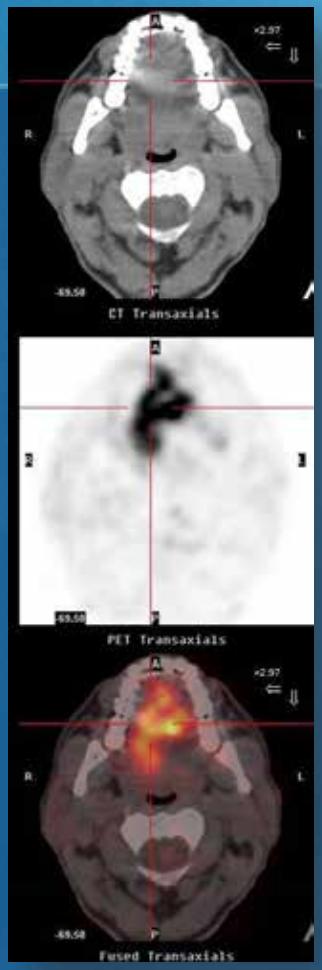
Estadificación PET-TC en cáncer de cabeza y cuello

Pharynx Staging Form

Clinical (Extent of disease before any treatment)	Stage Category Definitions	Pathologic (Extent of disease during and from surgery)
☐ y clinical– staging completed after neoadjuvant therapy but before subsequent surgery	Tumor Size: _____ Laterality: ☐ left ☐ right ☐ bilateral	☐ y pathologic – staging completed after neoadjuvant therapy AND subsequent surgery
	Primary Tumor (T)	
☐ TX	TX Primary tumor cannot be assessed	☐ TX
☐ T0	T0 No evidence of primary tumor	☐ T0
☐ Tis	Tis Carcinoma *in situ*	☐ Tis
	Nasopharynx	
☐ T1	Tumor confined to the nasopharynx, or extends to oropharynx and/or nasal cavity without parapharyngeal extension*	☐ T1
☐ T2	Tumor with parapharyngeal extension*	☐ T2
☐ T3	Tumor involves bony structures of skull base and/or paranasal sinuses	☐ T3
☐ T4	Tumor with intracranial extension and/or involvement of involvement of cranial nerves, hypopharynx, orbit, or with extension to the infratemporal fossa/ masticator space	☐ T4
	* Parapharyngeal extension denotes posterolateral infiltration of tumor.	
	Oropharynx	
☐ T1	Tumor 2 cm or less in greatest dimension	☐ T1
☐ T2	Tumor more than 2 cm but not more than 4 cm in greatest dimension	☐ T2
☐ T3	Tumor more than 4 cm in greatest dimension or extension to lingual surface of epiglottis	☐ T3
☐ T4a	Moderately advanced local disease. Tumor invades the larynx, extrinsic muscle of tongue, medial pterygoid, hard palate, or mandible*	☐ T4a
☐ T4b	Very advanced local disease. Tumor invades lateral pterygoid muscle, pterygoid plates, lateral nasopharynx, or skull base or encases carotid artery	☐ T4b
	* Mucosal extension to lingual surface of epiglottis from primary tumors of the base of the tongue and vallecula does not constitute invasion of larynx.	
	Hypopharynx	
☐ T1	Tumor limited to one subsite of hypopharynx and/or 2 cm or less in greatest dimension	☐ T1
☐ T2	Tumor invades more than one subsite of hypopharynx or an adjacent site, or measures more than 2 cm but not more than 4 cm in greatest dimension without fixation of hemilarynx	☐ T2
☐ T3	Tumor more than 4 cm in greatest dimension or with fixation of hemilarynx or extension to esophagus	☐ T3
☐ T4a	Moderately advanced local disease. Tumor invades thyroid/cricoid cartilage, hyoid bone, thyroid gland, or central compartment soft tissue*	☐ T4a
☐ T4b	Very advanced local disease. Tumor invades prevertebral fascia, encases carotid artery, or involves mediastinal structures	☐ T4b
	* Central compartment soft tissue includes prelaryngeal strap muscles and subcutaneous fat	

	Regional Lymph Nodes (N)	
	Nasopharynx The distribution and the prognostic impact of regional lymph node spread from nasopharynx cancer, particularly of the undifferentiated type, are different from those of other head and neck mucosal cancers and justify the use of a different N classification scheme.	
☐ NX	Regional lymph nodes cannot be assessed	☐ NX
☐ N0	No regional lymph node metastasis	☐ N0
☐ N1	Unilateral metastasis in lymph node(s), 6 cm or less in greatest dimension, above the supraclavicular fossa, and/or unilateral or bilateral, retropharyngeal lymph nodes, 6 cm or less, in greatest dimension*	☐ N1
☐ N2	Bilateral metastasis in lymph node(s), 6 cm or less in greatest dimension, above the supraclavicular fossa*	☐ N2
☐ N3	Metastasis in a lymph node(s)* >6 cm and/or extension to supraclavicular fossa	☐ N3
☐ N3a	Greater than 6 cm in dimension	☐ N3a
☐ N3b	Extension to the supraclavicular fossa**	☐ N3b
	* Midline nodes are considered ipsilateral nodes. **Supraclavicular zone or fossa is relevant to the staging of nasopharyngeal carcinoma and is the triangular region originally described by Ho. It is defined by three points: (1) the superior margin of the sternal end of the clavicle, (2) the superior margin of the lateral end of the clavicle, (3) the point where the neck meets the shoulder (see Fig. 4.2). Note that this would include caudal portions of Levels IV and VB. All cases with lymph nodes (whole or part) in the fossa are considered N3b.	
	Oropharynx and Hypopharynx	
☐ NX	Regional lymph nodes cannot be assessed	☐ NX
☐ N0	No regional lymph node metastasis	☐ N0
☐ N1	Metastasis in a single ipsilateral lymph node, 3 cm or less in greatest dimension	☐ N1
☐ N2	Metastasis in a single ipsilateral lymph node, more than 3 cm but not more than 6 cm in greatest dimension, or in multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension, or in bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension	☐ N2
☐ N2a	Metastasis in a single ipsilateral lymph node more than 3 cm but not more than 6 cm in greatest dimension	☐ N2a
☐ N2b	Metastasis in multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension	☐ N2b
☐ N2c	Metastasis in bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension	☐ N2c
☐ N3	Metastasis in a lymph node more than 6 cm in greatest dimension	☐ N3
	* Metastases at Level VII are considered regional lymph node metastases.	
	Distant Metastasis (M)	
☐ M0	No distant metastasis (no pathologic M0; use clinical M to complete stage group)	
☐ M1	Distant metastasis	☐ M1

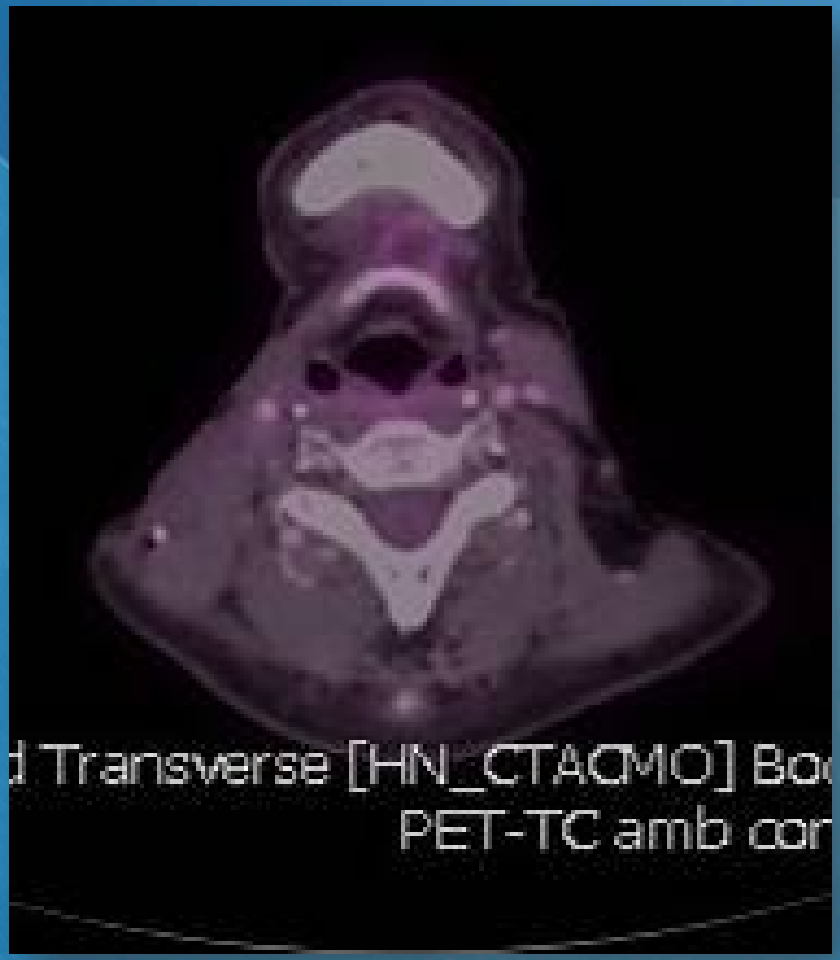
Estadificación T: limitaciones morfológicas



- Diagnóstico clínico / visual
- TAC/RM no detectan tumores con invasión < de 4 mm
- Sobreestimación del tamaño por PET
- Captaciones inespecíficas inflamatorias
- Útil el PET-CT con contraste yodado intravenoso
- Limitación en la afectación ósea:

RMN

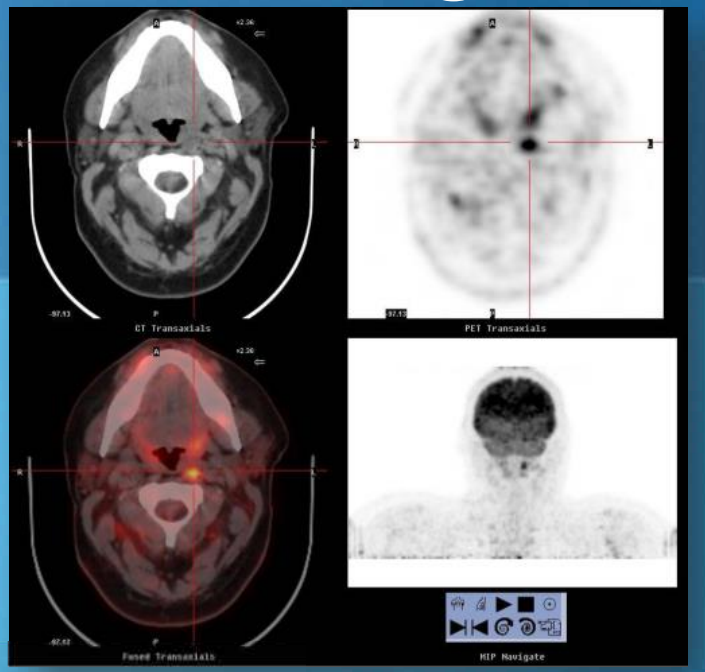
Estadificación T: limitaciones metabólicas



- **Tamaño de la lesión (detectabilidad vs resolución)**
- **Necrosis extensa**
- **Histología del tumor (carcinoma escamoso 80-90%)**

Estadificación N independencia morfológica

- Sensibilidad 87-90%
- Especificidad 80-95%
- Supera a técnicas de imagen convencionales
- Ventaja: elevado valor predictivo negativo
- Desventaja: incapaz de excluir micrometástasis (como en el resto de estudios de imagen)



Comparison of CT and ^{18}F-FDG PET for Staging of Lymph Node Involvement

Cancer (reference[s])	% Sensitivity		% Specificity	
	CT	^{18}F-FDG PET	CT	^{18}F-FDG PET
Head and neck (*19–25*)	36–86	50–96	56–100	88–100
NSCLC (*27–31*)	45	80–90	85	85–100
Cervical carcinoma (*34–36*)	57–73*	75–91	83–100*	92–100
Esophageal (*32*)	11–87	30–78	28–99	86–98

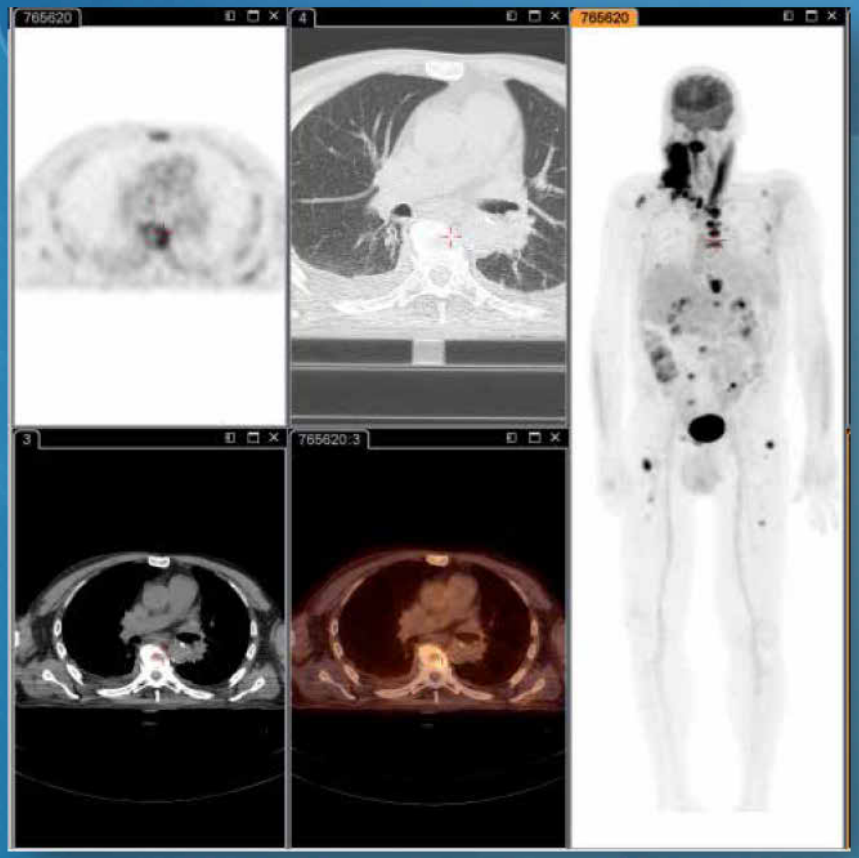
*CT or MRI.

***Maxillofac Surg*. 2011**

J Nucl Med 2007

J Natl Cancer Inst 2008

Estadificación M: estudio de cuerpo entero

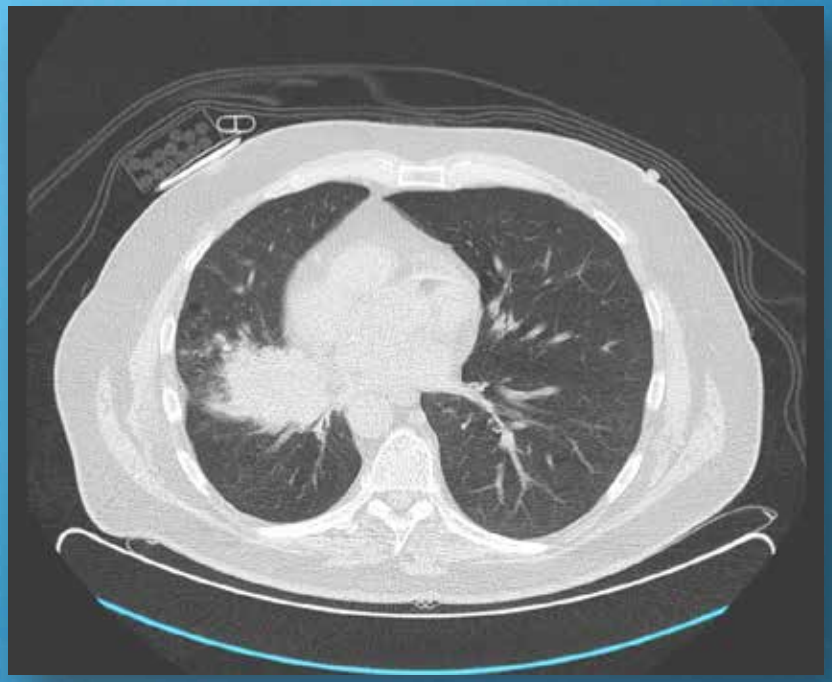


- M1 raras al diagnóstico dependiendo de la histología y de la localización
- Capacidad de rastreo de cuerpo entero
- Estadios T o N elevados

Neoplasias sincrónicas o metacrónicas

- Neoplasias sincrónicas o metacrónicas (10-30% de pacientes desarrolla un segundo tumor del tracto aéreo-digestivo en los 5 primeros años después del diagnóstico)

Chan SC *Eur J Nucl Med Mol Imaging* 2011
Hujala K *Eur Arch Otorhinolaryngol*. 2005



Contents lists available at ScienceDirect

Oral Oncology

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

Review

^{18}FDG-PET/CT for detecting distant metastases and second primary cancers in patients with head and neck cancer. A meta-analysis

Guo-Zeng Xu[a,b,1], De-Juan Guan[b,1], Zhi-Yi He[c,b,*]

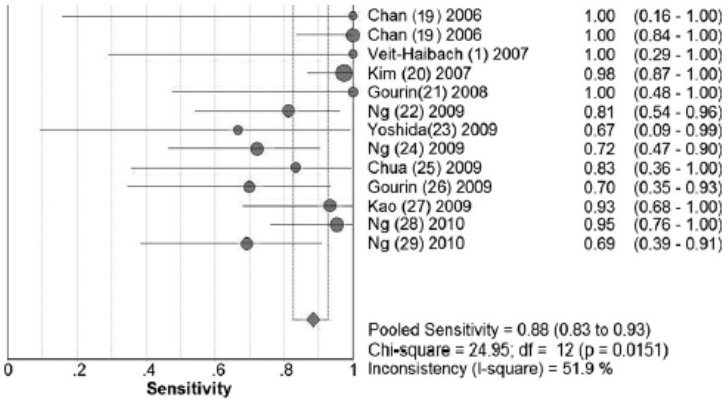


Figure 1 The forest plot of sensitivity of ^{18}FDG-PET/CT for distant metastases and second primary cancers in patients with head and neck cancer.

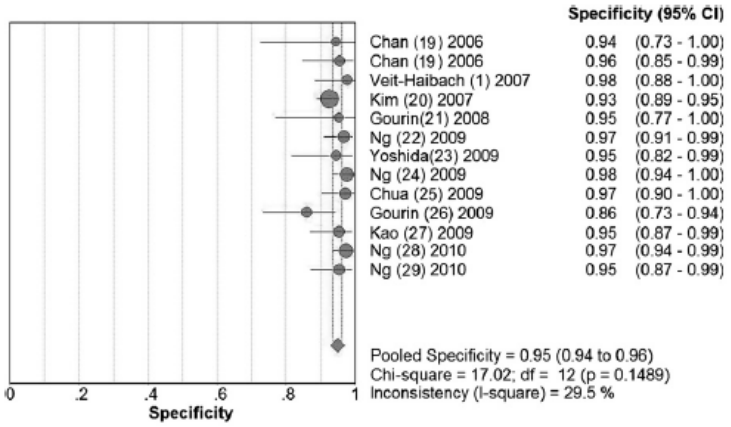


Figure 2 The forest plot of specificity of ^{18}FDG-PET/CT for distant metastases and second primary cancers in patients with head and neck cancer.

Chest CT and Whole-Body ^{18}F-FDG PET Are Cost-Effective in Screening for Distant Metastases in Head and Neck Cancer Patients

Carin A. Uyl-de Groot[1,2], Asaf Senft[3], Remco de Bree[3], C. René Leemans[3], and Otto S. Hoekstra[4]

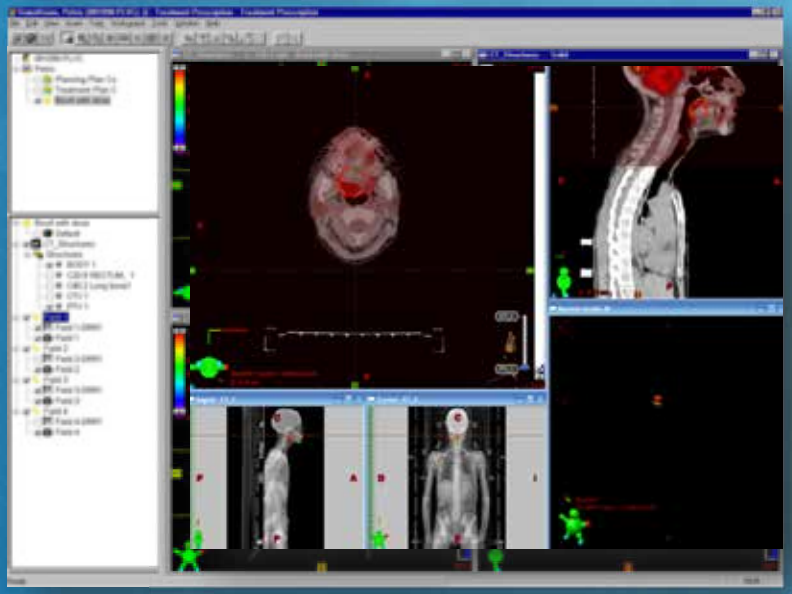
- Coste-efectividad en términos económicos (ahorro de radioterapia innecesaria).
- Coste-efectividad en términos de yatrogenia innecesaria (ahorro de efectos secundarios).
- Coste-efectividad en términos de supervivencia (posibilidad de tratamiento de segundos primarios).

J Nucl Med 2010; 51:176–182
DOI: 10.2967/jnumed.109.067371

PET-TC en la planificación de la radioterapia

- **Hasta 25% de modificación del GTV por PET**

Paulino AC, *Int J Radiat Oncol Biol Phys*. 2005



RESULTS

T WITHOUT CHANGES

N

N0 → N1 **3 PATIENTS**

N1 → N0 **1 PATIENTS**

4/12 (33%)

M

M0 → M1 **1 PATIENTS**

1/12 (8%)

* In one patient a synchronous pulmonary tumor was confirmed, but it did not exclude RT

Entonces…

T: PET-TC = TC < RM en algunas localizaciones

N: PET-TC > TC y RM

M: PET-TC evidentemente > TC y RM

Todo tiene un precio…

XXV CONGRÉS

Societat Catalano-Balear de Cirurgia Maxil·lofacial i Oral

Advances in oral and oropharyngeal cancer treatment

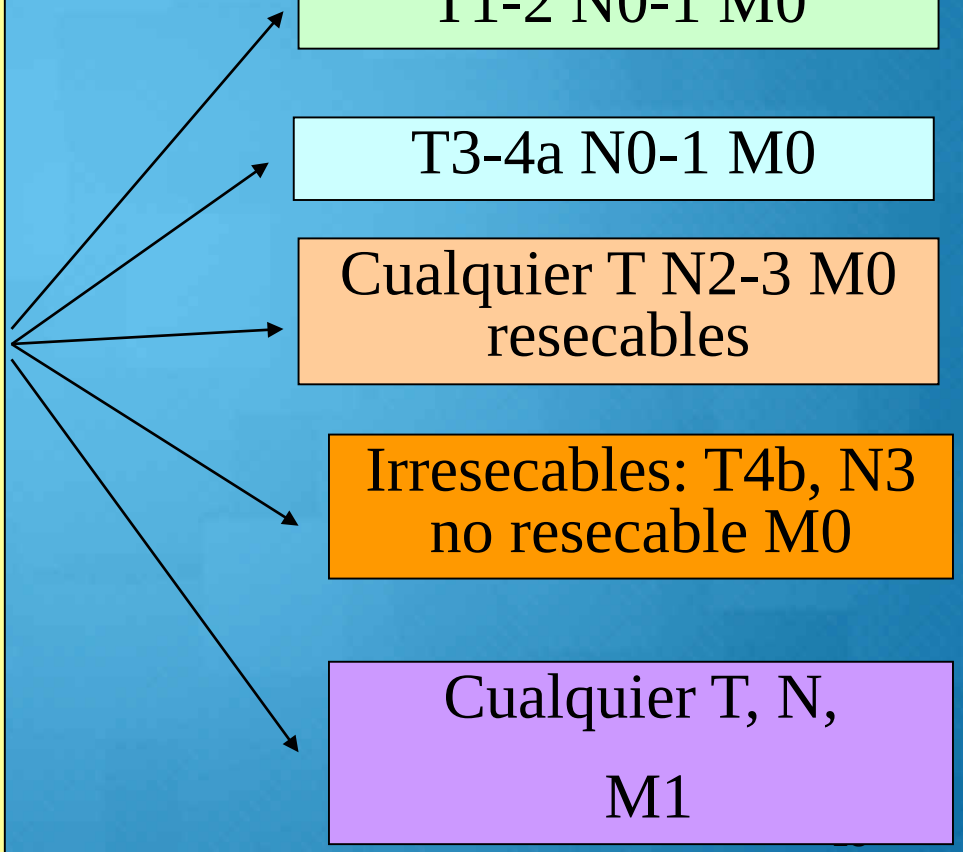
Quina és la millor prova d'imatge per estadificar els pacients amb carcinoma escatós de cap i coll?

Alejandro Fernández León
Medicina Nuclear
Hospital de Sant Pau
Barcelona

Protocolo diagnóstico orofaringe 2012

HOSPITAL DE LA SANTA CREU I SANT PAU
UNIVERSITAT AUTÒNOMA DE BARCELONA

- ü **Exploració ORL (cap i coll)**
- ü **Analítica general**
- ü **Rx Tòrax**
- ü **Biòpsia amb p16 i si positiu VPH**
- ü **RM/TC als estadis I-II**
- ü **PET-TC (amb contrast i sense contrast per utilitzar-lo també per planificar la radioteràpia) als estadis III-IV.**
- ü **Als casos necessaris exploració i biòpsia sota anestèsia general**



Protocolo diagnóstico nasofaringe 2012

HOSPITAL DE LA SANTA CREU I SANT PAU
UNIVERSITAT AUTÒNOMA DE BARCELONA

- ü Endoscòpia càvum + biòpsia
- ü Exploració ORL (cap i coll)
- ü Analítica general
- ü Rx. Tòrax
- ü RM càvum (+TC si hi ha afectació òssia)
- ü Estudi amb PET-TC (amb contrast i sense contrast per utilitzar-lo també per planificar la radioteràpia) per descartar metàstasis a distància al N2-3.

T1N0M0

T1N1-2M0
T2-3N0-1-2M0

T4N1-3
T1-3 N3a/b M0

Qualsevol T,
qualsevol N;
M1

Protocolo diagnóstico laringe 2012

- ü Exploració ORL
- ü Biòpsia
- ü Analítica general
- ü Rx. Tòrax
- ü TC laringe i coll (excepte T1a)
- ü A N3 i als N2 de més de 4 cm o amb ganglis al nivell IV, substituiríem la Rx. Tòrax i el TC laringe per un PET-TC (amb contrast).
- ü Als casos on es consideri necessari: exploració laringe sota anestèsia general.

Estadis inicials ressecables sense LT: majoria de T1-T2 N0 M0

Estadis ressecables amb LT. Dos grups diferents:
- T3
- T4a

No ressecables local o regional T4b o N3 no ressecable M0

Casos M1

Valoración de la respuesta terapéutica

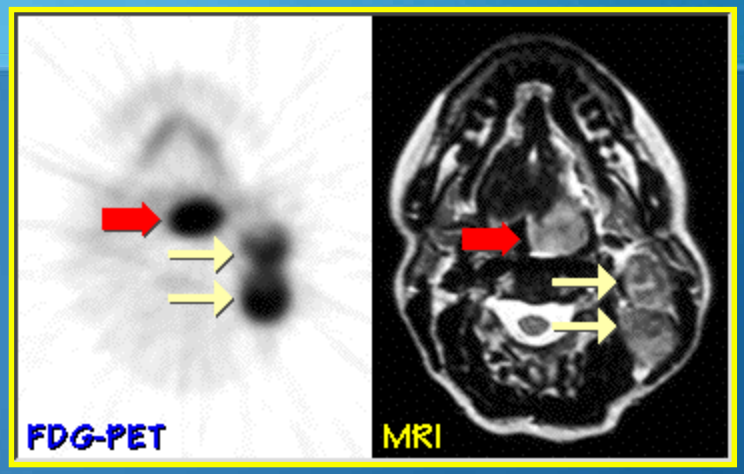
- **Limitación de métodos morfológicos (fibrosis, edema)**

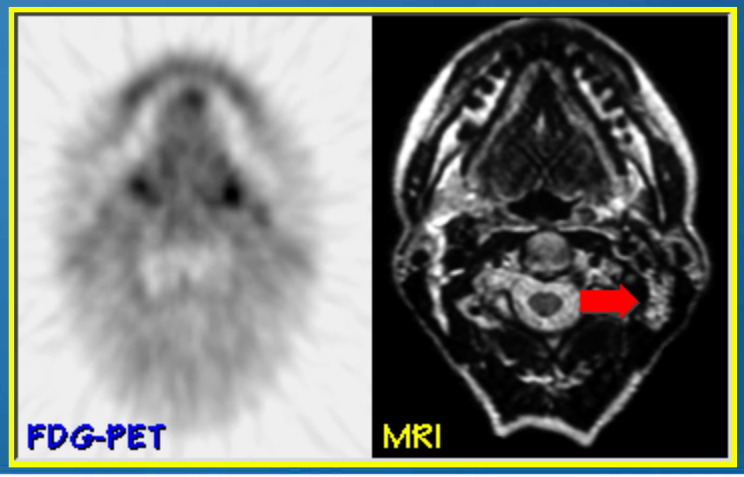
- **Utilidad en 2 contextos:**
  - **Detección de actividad residual post QTP o RDT (N2-N3?)**
  - **Distinción de respondedores de no respondedores**

- **RDT:** **E= 61% < 3 m**
  E= 90% >4 m*

- **QTP:** **E= 73-83% PET**
  E= 33-50%TAC**

Duet M Eur Ann Otorhinolaryngology 2010





Respuesta: falsos positivos

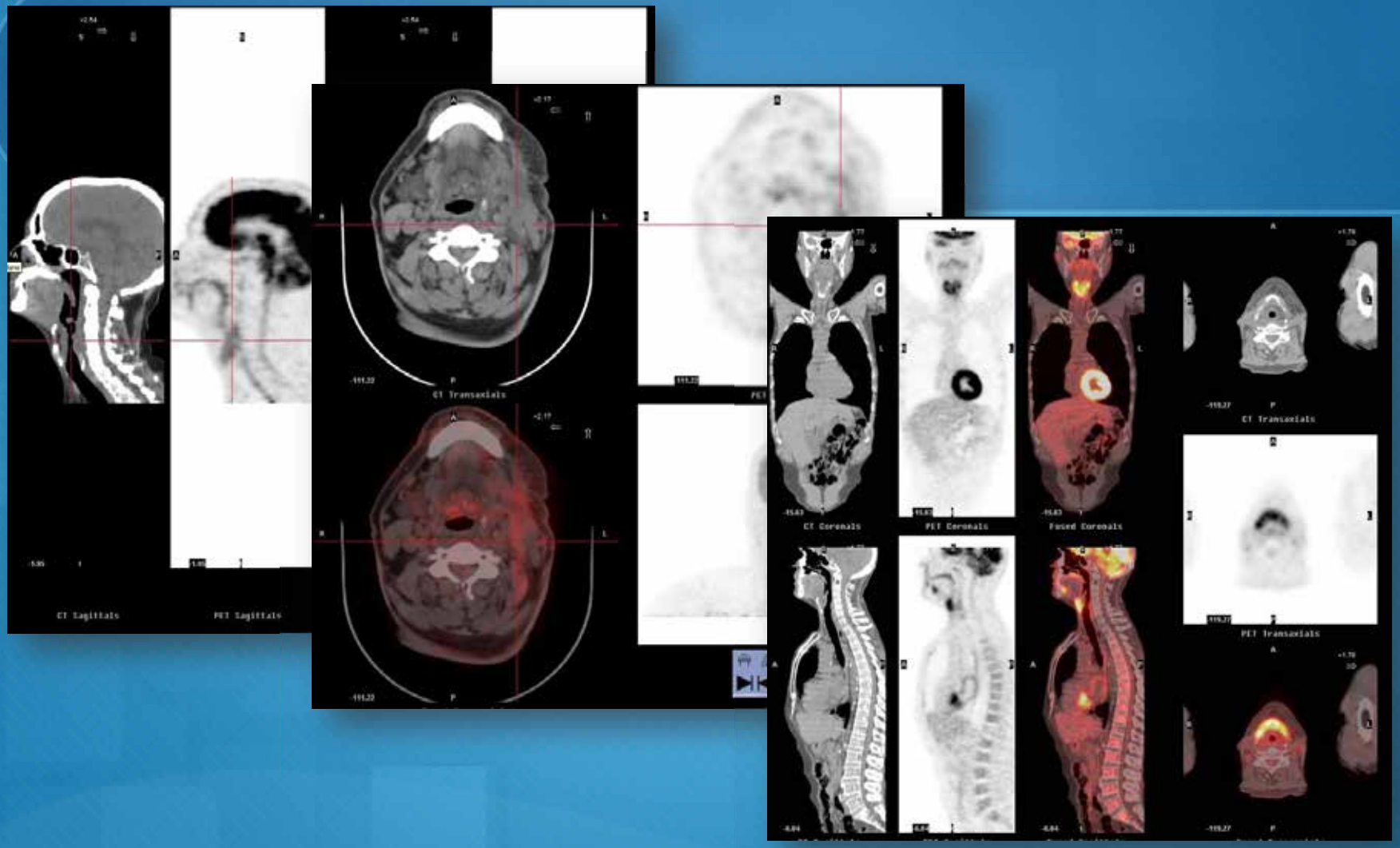
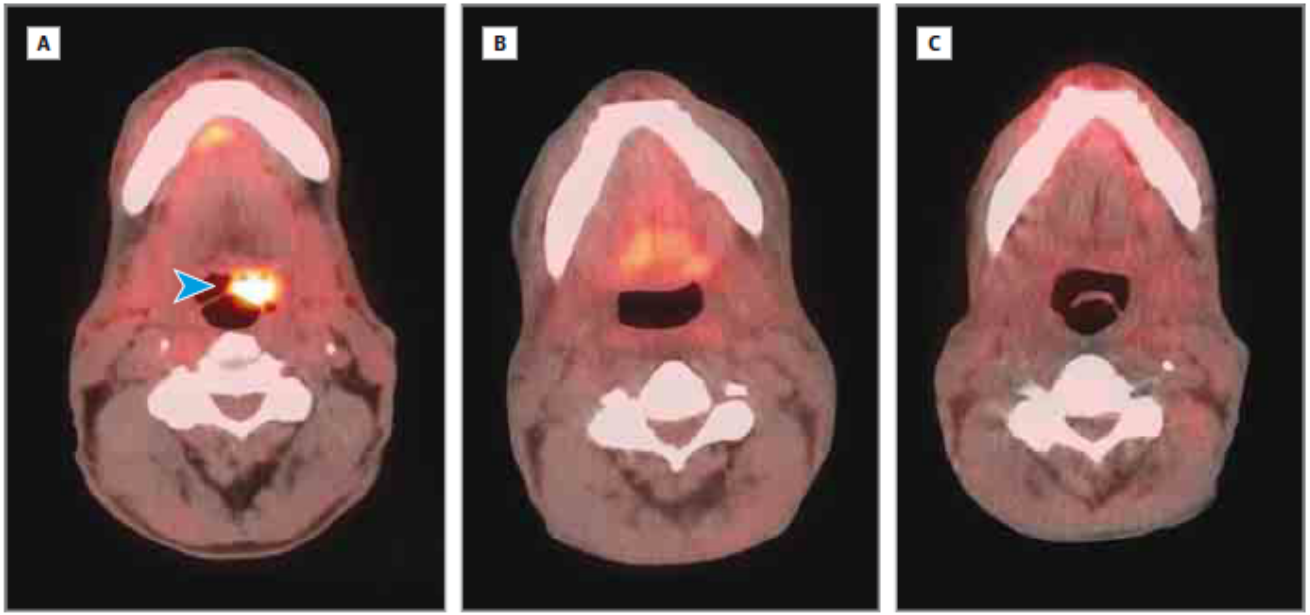


Figure 4. Therapy Assessment

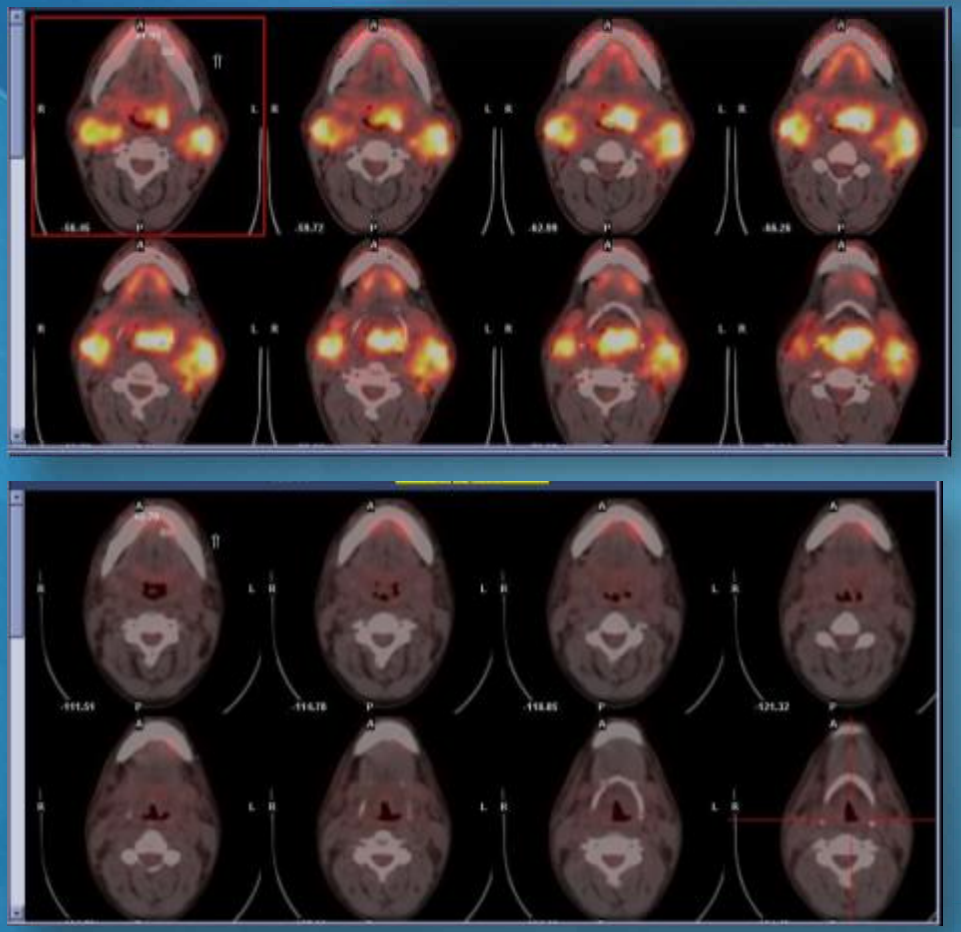


A, Axial fused positron emission tomography/computed tomography (PET/CT) image of initial scan of a man in his 60s with a history of left tongue base squamous cell carcinoma, which presented as a fludeoxyglucose-avid lesion (standard uptake value, 9.99) (arrowhead) in PET/CT. The patient was treated with chemoradiation (9 weeks cetuximab, 7000 cGy). B, Three months after treatment, PET/CT scan showed good response with diffuse uptake suggestive of postradiotherapy inflammation (diffuse uptake, standard uptake value, 6.74). C, The 9-month follow-up PET/CT showed complete response without any interval treatment.

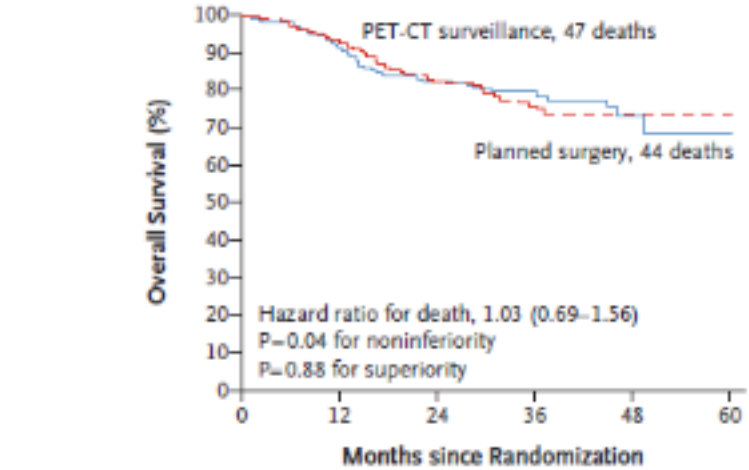
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

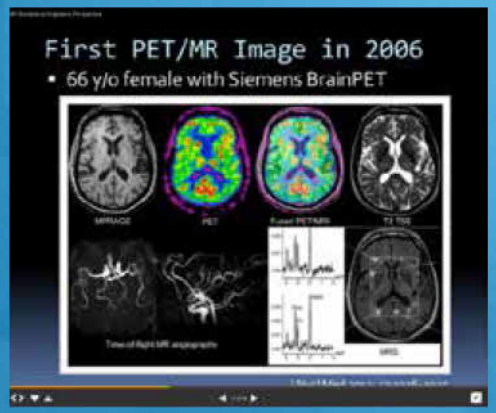
PET-CT Surveillance versus Neck Dissection in Advanced Head and Neck Cancer



From 2007 through 2012, we recruited 564 patients



¿Y EL PET / RM?

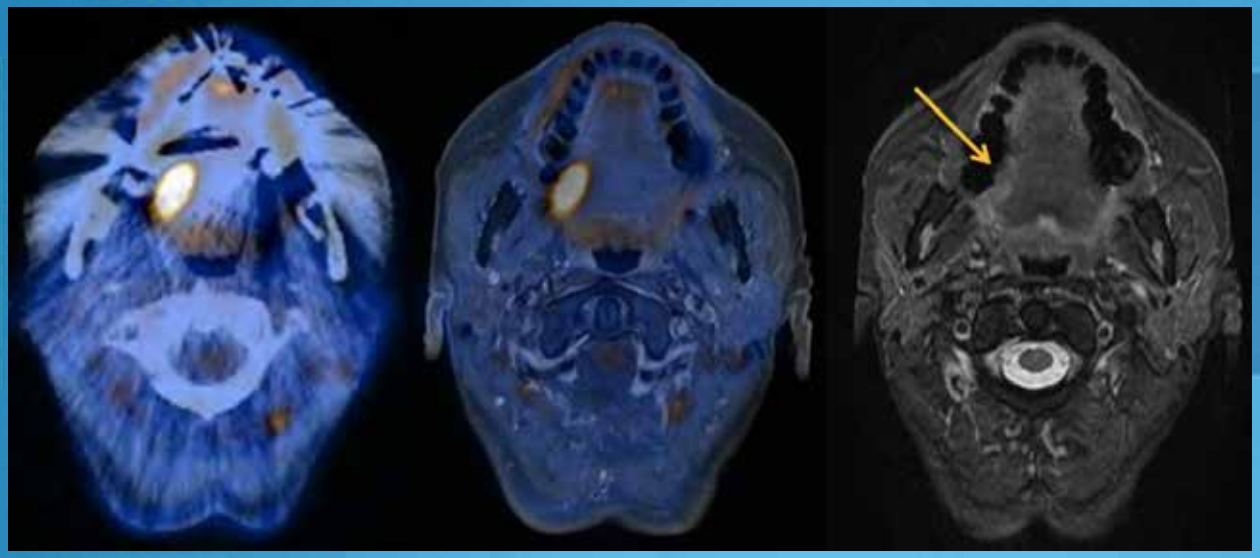


VENTAJAS

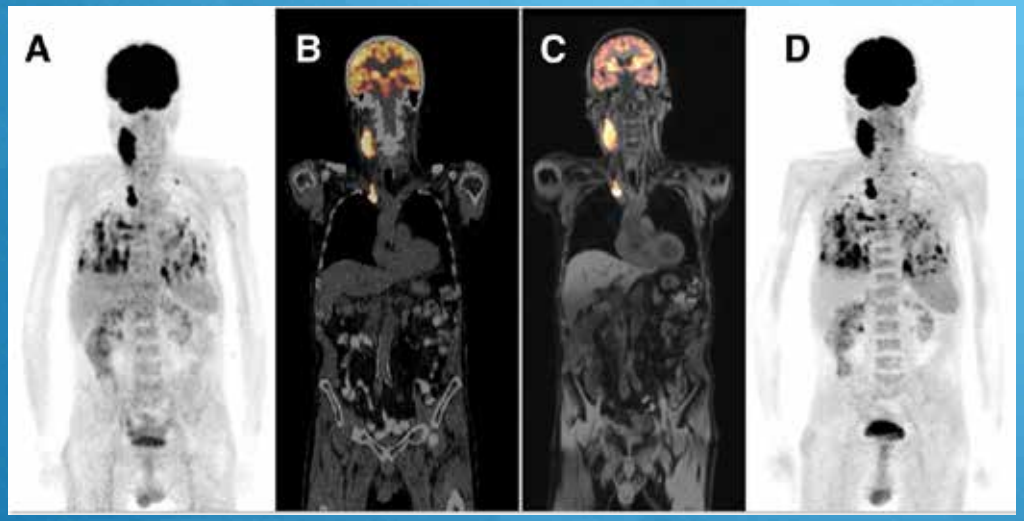
- Menor radiación*
- Menos artefactos dentarios
- Diferentes secuencias RM
- Mejor caracterización tisular

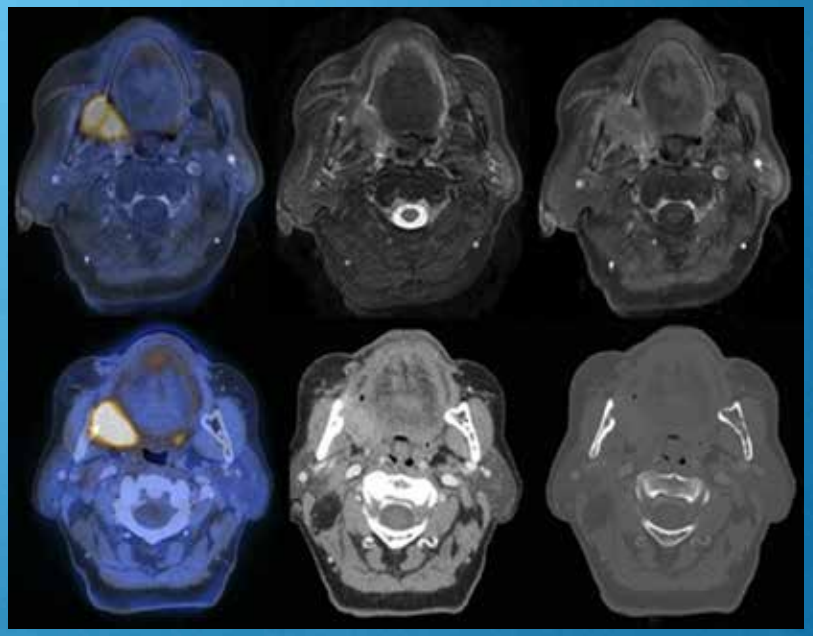
INCONVENIENTES

- Mayor tiempo adquisición
- Limitación pulmón
- Marcapasos
- Corrección por atenuación
- Precio



jnm.snmjournals.org





Eur J Nucl Med Mol Imaging (2015) 42:42–48
DOI 10.1007/s00259-014-2885-5

ORIGINAL ARTICLE

Diagnostic accuracy of whole-body PET/MRI and whole-body PET/CT for TNM staging in oncology

Philipp Heusch · Felix Nensa · Benedikt Schaarschmidt · Rupika Sivanesapillai · Karsten Beiderwellen · Benedikt Gomez · Jens Köhler · Henning Reis · Verena Ruhlmann · Christian Buchbender

Table 1 Accuracy of FDG PET/CT and FDG PET/MRI in the detection of lymph node involvement and distant metastases in relation to the reference standard

Modality	True-positive (*n*)		True-negative (*n*)		False-positive (*n*)		False-negative (*n*)	
	Lymph nodes	Distant metastases	Lymph nodes	Distant metastases	Lymph nodes	Distant metastases	Lymph nodes	Distant metastases
FDG PET/CT	11	4	47	27	3	6	6	5
FDG PET/MRI	13	4	45	30	3	3	6	5

Gracias por vuestra atención…