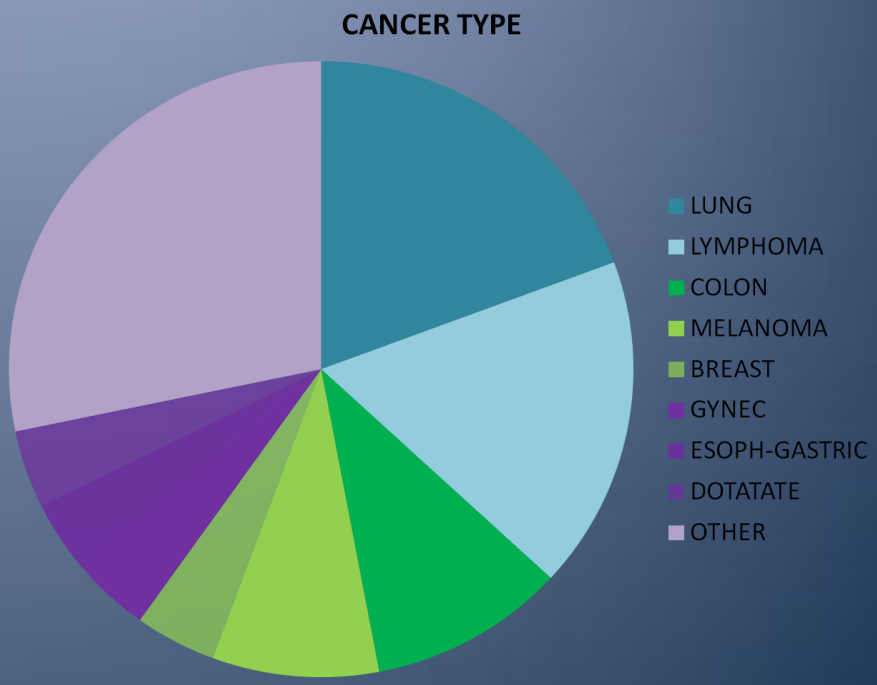
APLICACIONES 18F-FDG PET/CT EN HEMATO-ONCOLOGIA

DRA FRANCISCA REDONDO M.
SERVICIO DE MEDICINA NUCLEAR Y PET/CT FALP
OCTUBRE 2013

PET/CT FALP OCTUBRE 2013

TOTAL	15000 ESTUDIOS	
LUNG	2985	(19.9%)
LYMPHOMA	2574	(17.2%)
COLON	1541	(10.3%)
MELANOMA	1307	(8.7%)

BREAST
GINEC
ESOPH-GASTRIC
GALLBLADDER
HEAD & NECK
DOTATATE



LINFOMA

CLASIFICACION CLINICA

90%

Table 12-5 Non-Hodgkin lymphoma: indolent versus aggressive subtypes.

Indolent lymphomas	Aggressive lymphomas
B cell	
CLL/SLL	Mantle cell
Follicular, grades I, II, IIIa	Follicular, grade 3b
Marginal zone	Diffuse large B cell
MALT	Mediastinal large B cell
Nodal	Burkitt and Burkitt-like Precursor B-lymphoblastic
T cell	
Mycosis fungoides/Sézary syndrome	Systemic ALCL Peripheral T cell
Primary cutaneous ALCL	Precursor T-lymphoblastic Adult T-cell leukemia/lymphoma

ALCL = anaplastic large cell lymphoma; CLL = chronic lymphocytic leukemia; MALT = mucosa-associated lymphoid tissue; SLL = small lymphocytic lymphoma.

ETAPIFICACION

- Mayor sensibilidad que cualquier otra técnica imágenes etapificación inicial: Sensibilidad 90-96%, Especificidad 94-99%
- Mayor rendimiento **LINFOMAS DE ALTO GRADO:**
  - LH, LDCGB, LF (interm/alto) y MCL: ~ 98-100%
  - LLCP, LCTP: 40-50%
  - LZM (MALT): ~ 67%
- Cambio estadío en 20- 40% casos
- Cambio conducta terapéutica en 20-25% casos

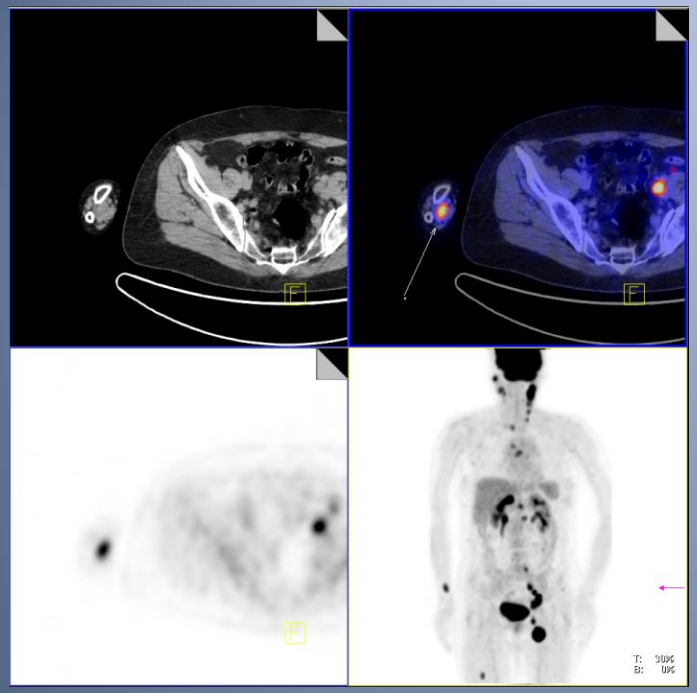
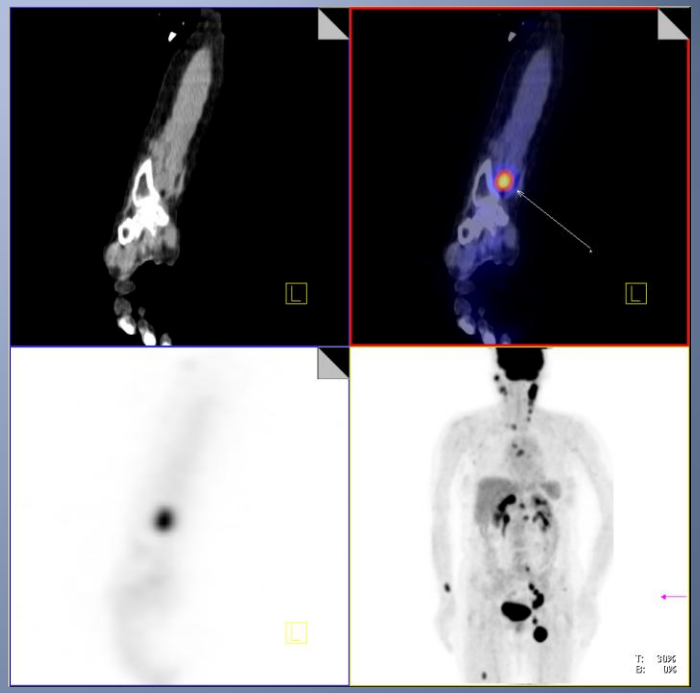
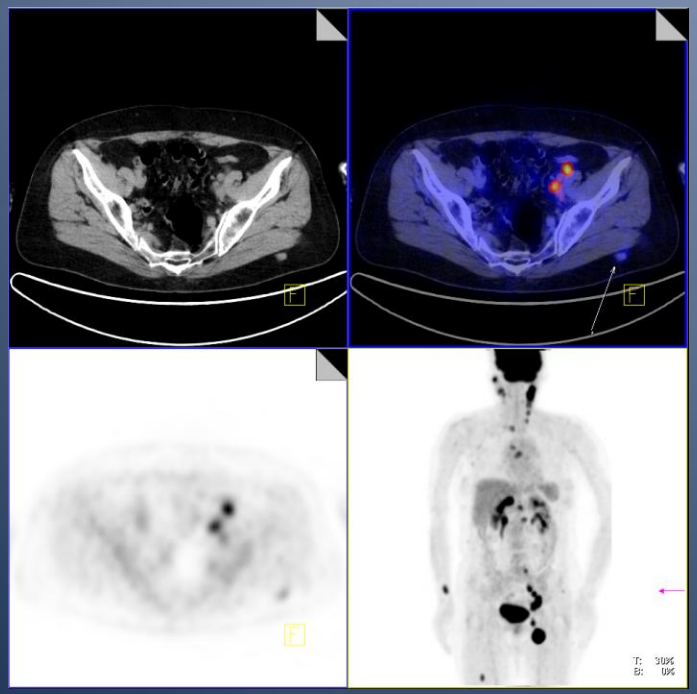
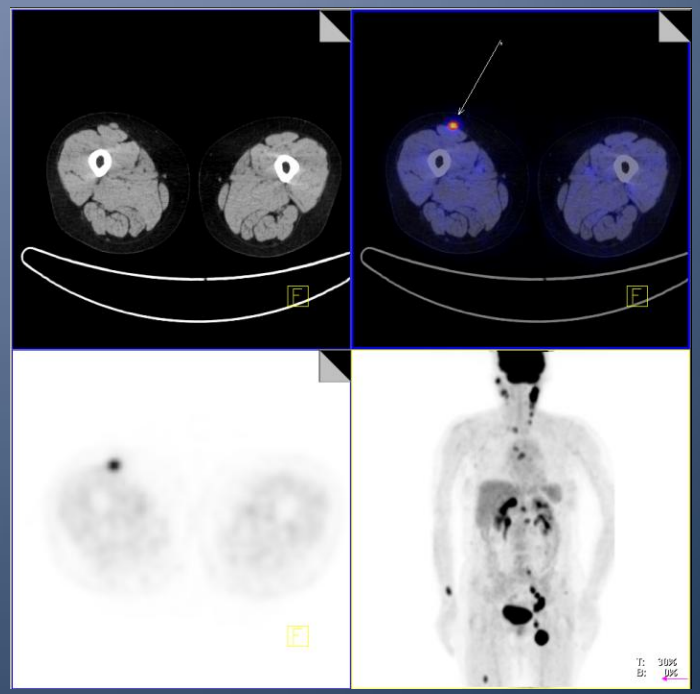





Table 1. Sensitivity/Specificity of PET *v* CT in HL/NHL Staging

Study	No. of Patients	Modality	Sensitivity (%)	Specificity (%)
Newman[13]	16	PET	100	100
		CT	91	100
Thill[14]	27	PET	100	NA
		CT	77	
Buchman[16]	52	PET (N)	99.2	100
		CT (N)	83.2	99.8
		PET (E)	100	99.4
		CT (E)	80.8	99.4
Schaefer[17]	60	PET/CT	94	100
		CT	88	86
Hutchings[18]	99	PET/CT (N)	92.2	99.3
		CT	82.6	98.9

Abbreviations: PET, positron emission tomography; CT, computed tomography; HL, Hodgkin's lymphoma; NHL, non-Hodgkin's lymphoma; NA, not applicable; N, nodal; E, extranodal.

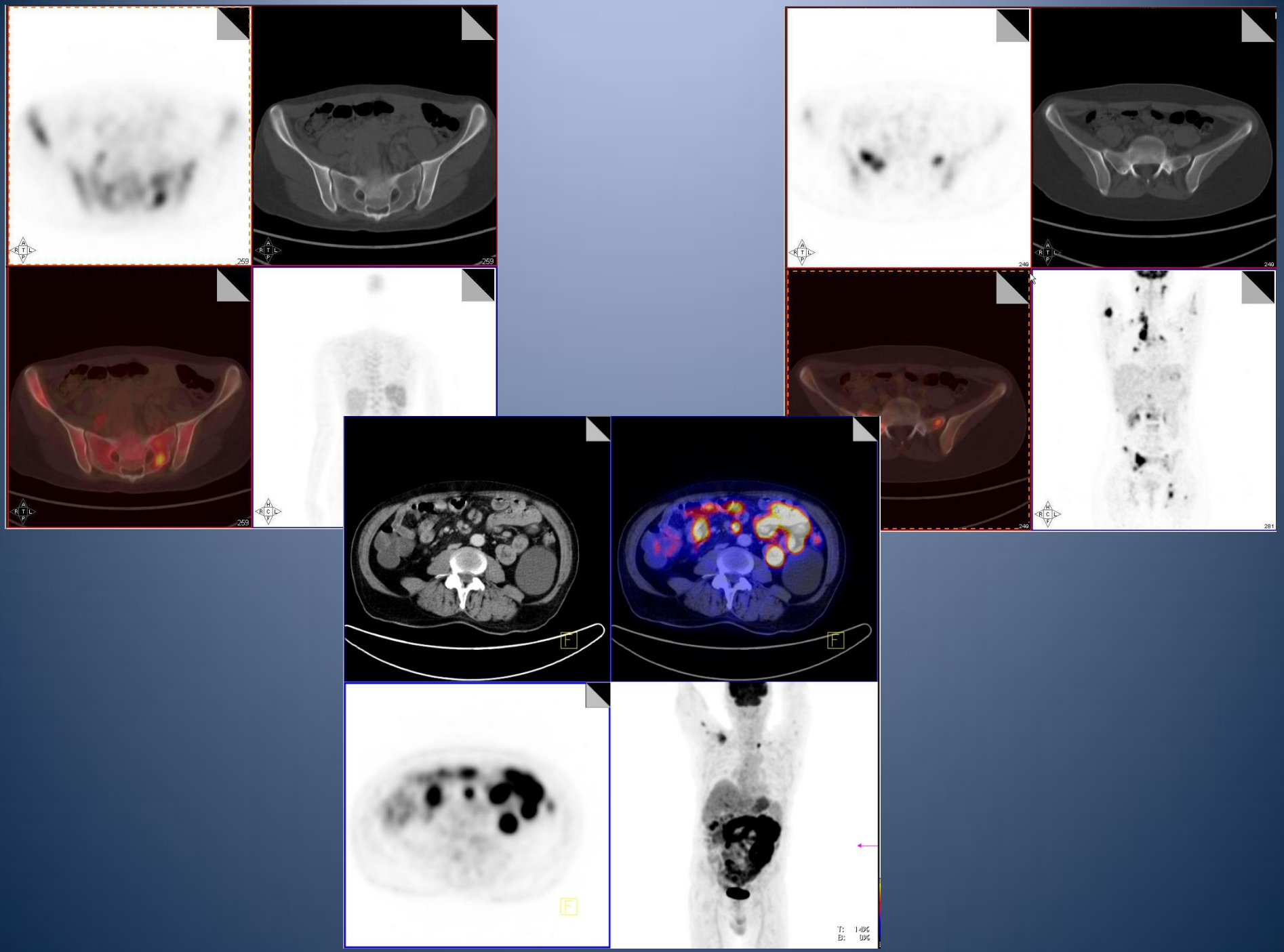
COMPROMISO EXTRANODAL

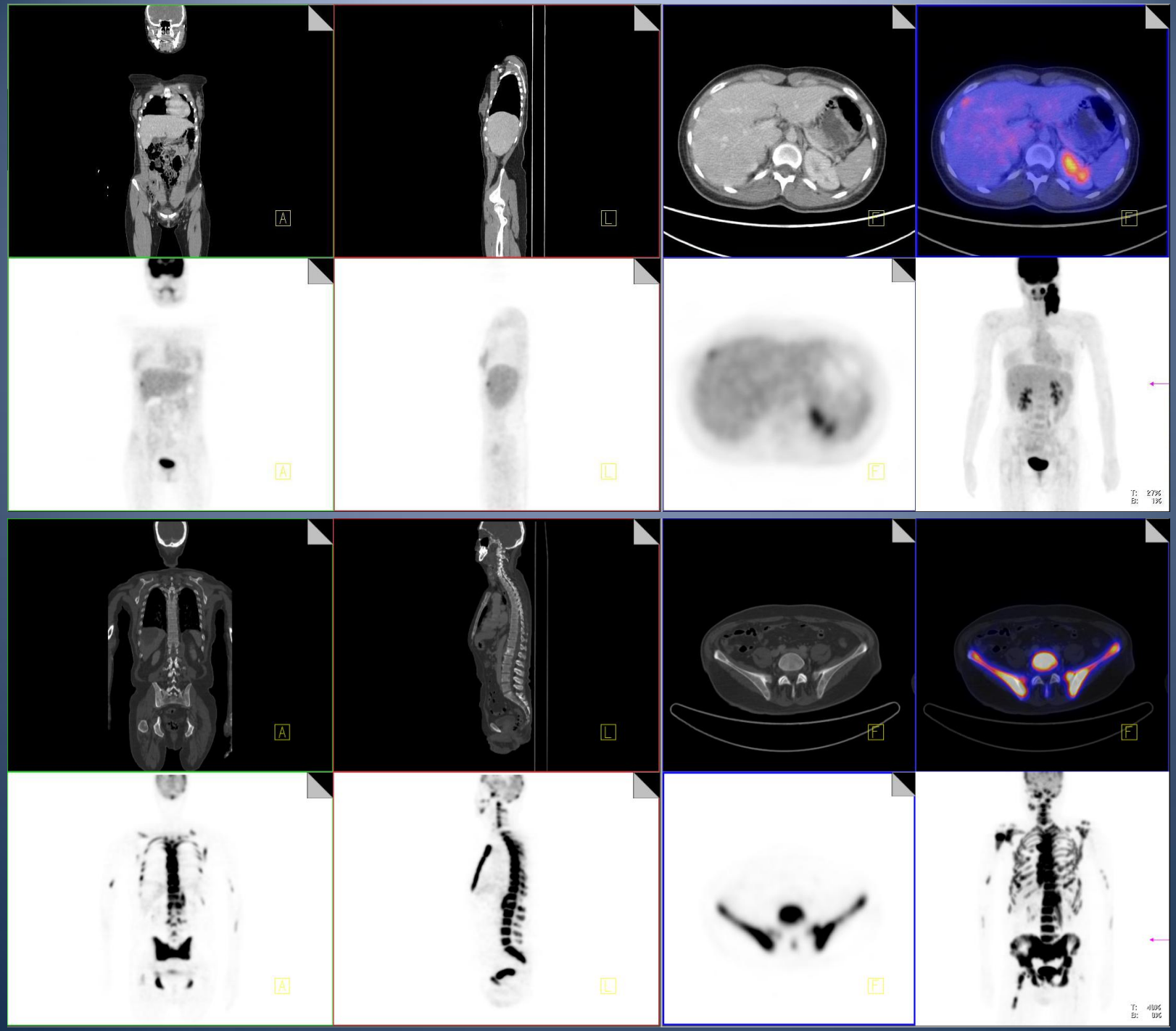
MEDULA OSEA

Table 3. FDG-PET *v* BM Biopsy in HL

Study	No. of Patients	No. BM Positive/PET Negative	No. BM and PET Positive	BM Negative/ PET Positive	
				No.	%
Carr[38]	12	2	2	4	33
Moog[39]	39	4	4	3	7.7
Jerusalem[21]	33	2	1	0	
Munker[26]	73	3	2	6	8.2
Kabickova[28]	55	4	4	6	10.9
Rigacci[22]	186	6	5	14	7.5
Pelosi[19]	82	6	2	11	13.4
Cerci[41]	82	16	16	4	4.9
Moulin-Romsee[40]	83	7	7	9	10.7
Total	614	50	43	56	9.1
%		8	7		

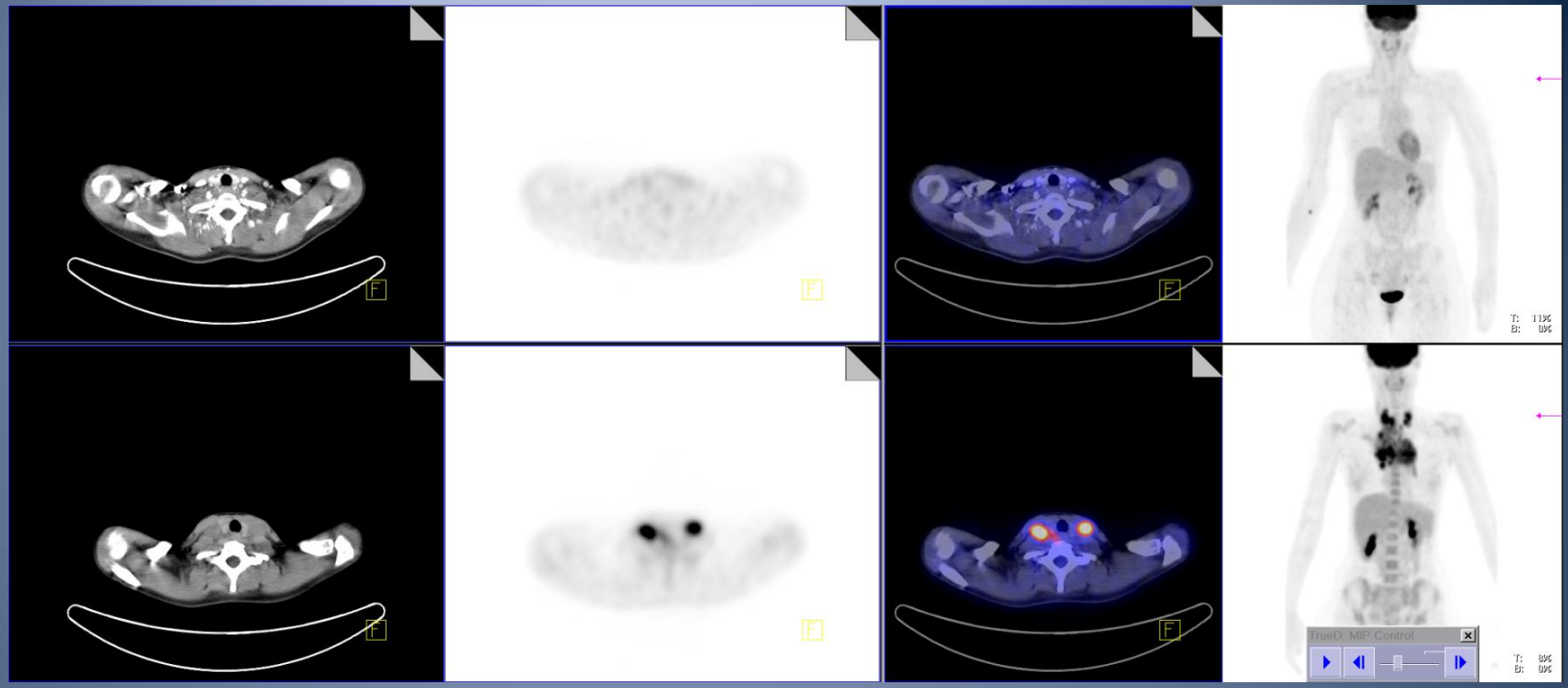
Abbreviations: FDG, fluorodeoxyglucose; PET, positron emission tomography; BM, bone marrow; HL, Hodgkin's lymphoma.

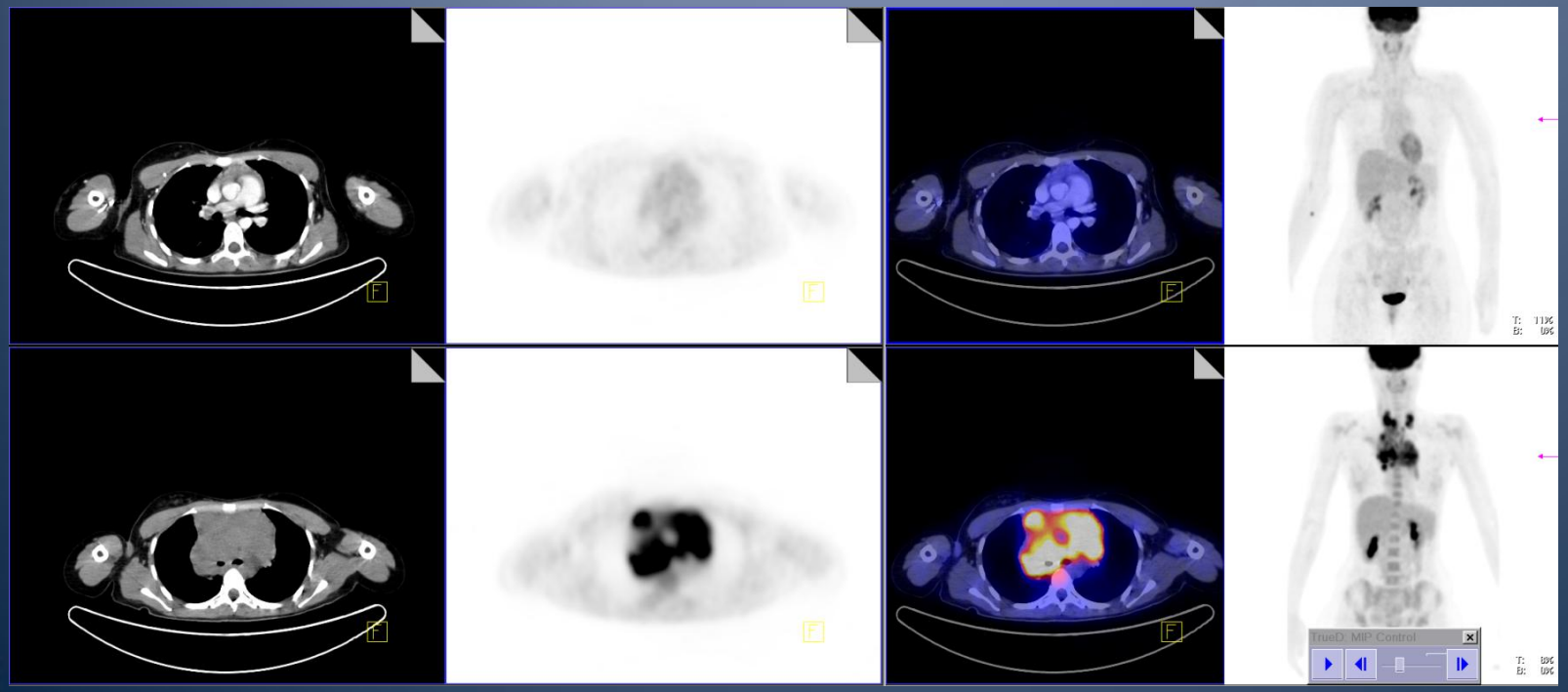


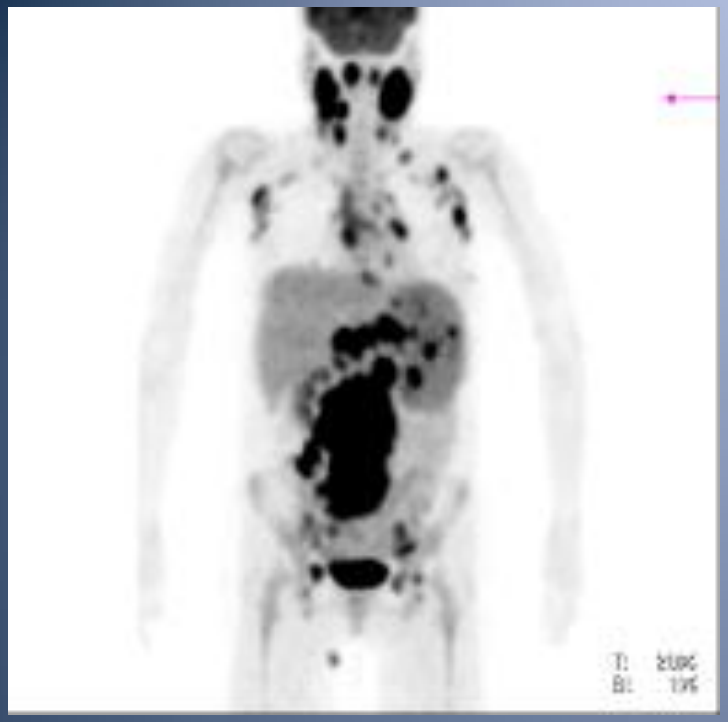


CONTROL TERAPIA

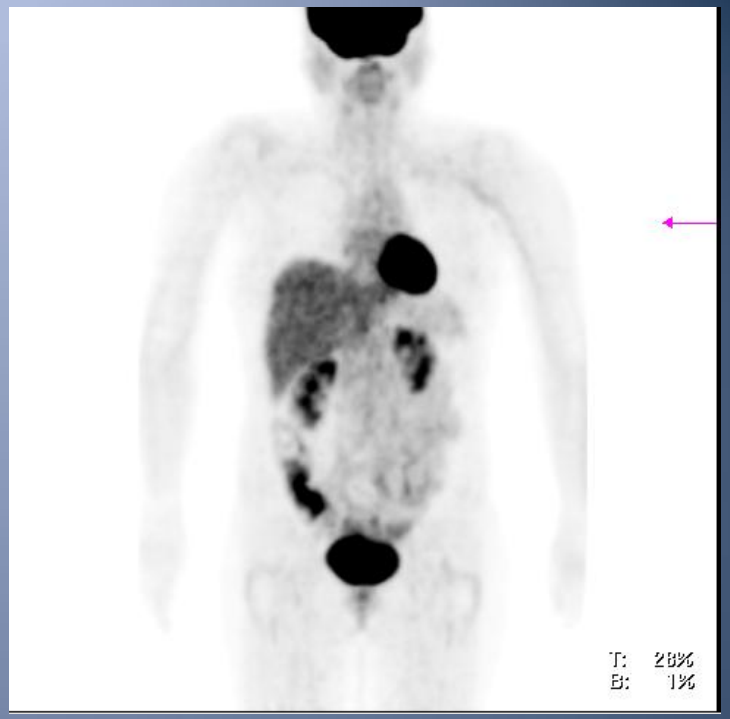
- I-PET
- F-PET
- ROL SUV


TrueD: MIP Control

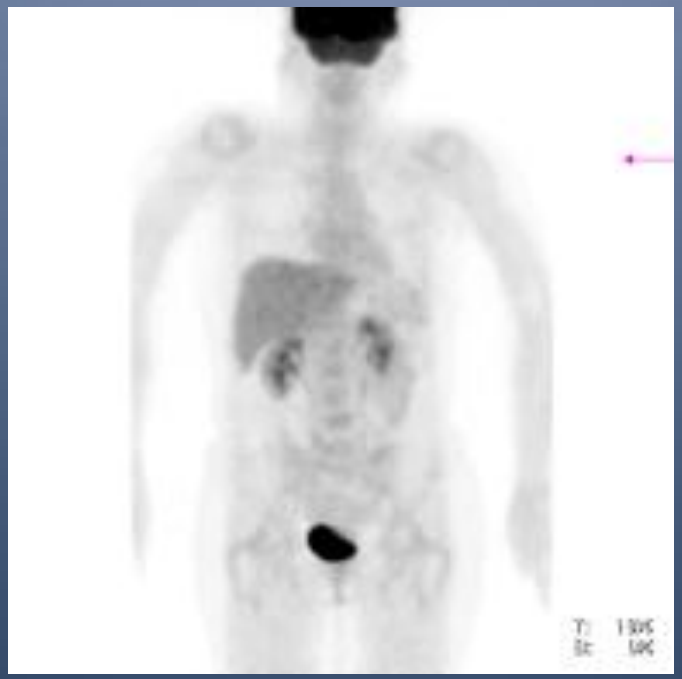

TrueD: MIP Control



BASAL

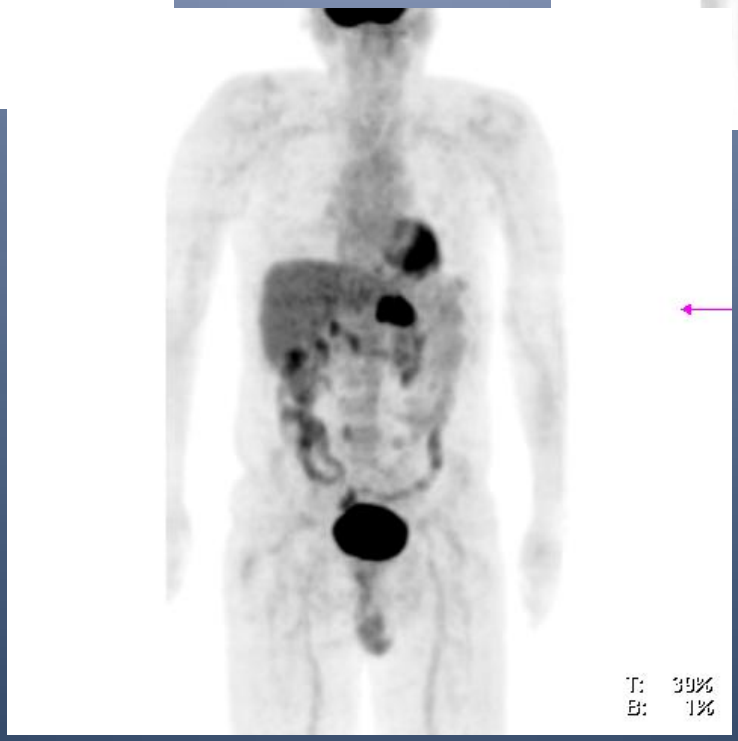


POST 2 CICLOS



8 SEMANAS POST TTO

BASAL



8 SEMANAS POST TTO

POST 2 CICLOS

VOLUME 30 · NUMBER 2 · JANUARY 10 2012

JOURNAL OF CLINICAL ONCOLOGY

ORIGINAL REPORT

Interim [^{18}F]Fluorodeoxyglucose Positron Emission Tomography Scan in Diffuse Large B-Cell Lymphoma Treated With Anthracycline-Based Chemotherapy Plus Rituximab

Violaine Safar, Jehan Dupuis, Emmanuel Itti, Fabrice Jardin, Christophe Fruchart, Stéphane Bardet, Pierre Véra, Christiane Copie-Bergman, Alain Rahmouni, Hervé Tilly, Michel Meignan, and Corinne Haioun

Table 3. Summary of the Primary Studies on PET Interim Assessment in Aggressive Lymphoma

Study Author	No. of Patients		Treated With Rituximab (%)	Median Follow-Up (months)	Cycles Completed at Time of PET Scan Performed (No.)	End Point	
	Total	DLBCL				Negative PET	Positive PET
Jerusalem[4]	28	16		17.5	2-5	2-year PFS: 62% 2-year OS: 68%	2-year PFS: 0% 2-year OS: 0%
Spaepen[5]	70	47		36.3	3-4	2-year PFS: 85% 2-year OS: 90%	2-year PFS: 4% 2-year OS: 40%
Kostakoglu[6]	30	13		19	1	1.5-year PFS: 85%	1.5-year PFS: < 15%
Mikhaeel[7]	121	75	?	24.4	2-3	5-year PFS: 89% 5-year OS: 90%	5-year PFS: 16% 5-year OS: 63%
Haioun[3]	90	85	41	24	2	2-year EFS: 82% 2-year OS: 90%	2-year EFS: 43% 2-year OS: 61%
Dupuis[8]	103	103	49	33	2	5-year EFS: 80%	5-year EFS: 36%
Fruchart[9]	40	35	?		2-3	2-year EFS: 85%	2-year EFS: 30%
Casasnovas[25]	102	102	100	19	2-4	2-year PFS: 81%	2-year PFS: 73%

Abbreviations: EFS, event-free survival; DLBCL, diffuse large B-cell lymphoma; OS, overall survival; PET, positron emission tomography; PFS, progression-free survival.

VOLUME 29 · NUMBER 14 · MAY 10 2011

JOURNAL OF CLINICAL ONCOLOGY

REVIEW ARTICLE

Role of Functional Imaging in the Management of Lymphoma

Bruce D. Cheson

Table 5. Interim PET in HL and DLCBL

Study	No. of Patients With HL	No. of Patients With NHL	Cycles of Therapy	PET Negative (%)	PFS/EFS (%)	PET Positive (%)	PFS/EFS (%)
Jerusalem[65]		28	2-3	82	100	18	30
Spaepen[66]		47	3-4	47	84	53	0
Haioun[67]		90	2	60	82	40	43
Mikhaeel[69]		121	2-3	41.3	93	43	30
Kostakoglu[73]	23		1	74	100	26	12.5
		24		58	100	42	
Zinzani[74]		91	Various	61.5	89	38.5	17
Safar[75]		112	2	63	81	37	41
Cashen[50]		50	2-3	30	85	30	75
Gigli[49]		42	3	67	90	33	55
Micallef[76]		76	2	79	73	21	60
Pregno[77]		82	2	67	84	33	74
Hutchings[70]	85		2-3	72	94	13	38
Hutchings[71]	77		2	79	95	21	31
Zinzani[72]	40		2	80	97	20	12
Gallamini[79]	260		2	81	95	19	14
Markova[78]	50		4	72	100	28	86

Abbreviations: PET, positron emission tomography; HL, Hodgkin's lymphoma; DLCBL, diffuse large B-cell lymphoma; NHL, non-Hodgkin's lymphoma; PFS, progression-free survival; EFS, event-free survival.

SUV

- Standarized Uptake Value
- Medida semicuantitativa del metabolismo glucídico
- NO EXISTE VALOR DE CORTE para diferenciar lesiones benignas de malignas
- INDISPENSABLE ESTUDIO BASAL
- INDISPENSABLE REPETIR ESTUDIOS EN MISMO CENTRO, MISMO EQUIPO Y MISMAS CONDICIONES

F-PET

- Alto VPN
- Mejor predictor pronóstico
- Masas residuales: viabilidad v/s fibrosis

Cerci et al[52] assessed the cost effectiveness of FDG-PET/PET for patients in unconfirmed CR (CRu) or partial remission (PR) after first-line therapy for HL. FDG-PET demonstrated 95.9% accuracy in restaging and was found to be highly cost effective, with PET contributing only 1% of the cost of HL treatment. In a recent report of the HD15 trial from the German Hodgkin Study Group,[51] post-treatment PET scans were able to reduce the number of patients irradiated for residual disease to 11% from 70% in previous trials.

Table 4. PET(CT) in Restaging of Lymphoma

Study	No. of Patients	PPV (%)	NPV (%)
NHL			
Bangerter[20]	89	90	98
Jerusalem[42]	35	42.9	100
Zinzani[47]	31	92.9	100
Mikhaeel[44]	45	60	100
Naumann[48]	15	85.7	88.2
Spaepen[45]	93	70.3	100
Cashen[50]	50	80	92
Gigli[49]	42	75	94
HL			
Spaepen[46]	60	100	91
Engert[51]	728	NA	94.6
Cerci[52]	130	92.3	100

Abbreviations: PET, positron emission tomography; CT, computed tomography; PPV, positive predictive value; NPV, negative predictive value; NHL, non-Hodgkin's lymphoma; HL, Hodgkin's lymphoma; NA, not applicable.

F-PET

- QT: MINIMO 4 semanas
- RT: MINIMO 8-12 semanas
- Ausencia de cuadro infeccioso intercurrente
- Antecedentes clínicos

TRANSFORMACION

- Punto de quiebre evolución linfomas indolentes
- Requiere cambio terapia e implica cambio pronóstico
- Linfomas indolentes escasa captación 18F-FDG, evidencian focos intensamente hipermetabólicos
- Permite identificar mejor sitio de biopsia

original article

Annals of Oncology 20: 508–512, 2009
doi:10.1093/annonc/mdn657
Published online 12 January 2009

The majority of transformed lymphomas have high standardized uptake values (SUVs) on positron emission tomography (PET) scanning similar to diffuse large B-cell lymphoma (DLBCL)

A. Noy[1]*, H. Schöder[2], M. Gönen[3], M. Weissler[4], K. Ertelt[5], C. Cohler[6], C. Portlock[1], P. Hamlin[1] & H. W. D. Yeung[2]

[1]*Department of Medicine, Lymphoma Service;* [2]*Department of Radiology, Nuclear Medicine;* [3]*Department of Epidemiology and Biostatistics, Memorial Sloan-Kettering Cancer Center, New York;* [4]*Department of Medicine, New York-Presbyterian, Weill-Cornell Medical Center, New York;* [5]*Humboldt University, Berlin, Germany;* [6]*University of Pennsylvania, Philadelphia, USA*

Table 2. Patients with serial PET scanning at indolent and aggressive diagnosis

UPIN	Indolent diagnosis	SUV range (g/dl)	SUV at biopsy site (g/dl)	$SUV_{study\text{-}max}$ (g/dl)	Subsequent transformed diagnosis	SUV range	SUV at biopsy site	$SUV_{study\text{-}max}$ (g/dl)
4	FL 3a	13	Excised	13	DLBCL	5.4–20.3	20.3	20.3
6	FL 1	1.5–3	Excised	3	LCL	10.9–22.5	22.5	22.5
8	FL 1	4.6–8.5	4.6–8.5	8.5	LCL	9–20.8	12.1	20.8
12	MZL	2.8–6.3	None	6.3	DLBCL	9.7	9.7	9.7
17	MZL (MALT type)	4.9–11.5	11.5	11.5	DLBCL	2.6–7.1	7.1	7.1
29	FL 2	2.5–10.5	6.8	10.5	DLBCL	2.8–8.2	Excised	8.2
30	FL 2	2–13.5	1.5	13.5	DLBC	3–16.4	16.4	16.4
31	SLL	5.5–14.5	5.5	14.5	DLBCL	8.1–40	33.5	40
32	MZL	2–7.1	6.2	7.1	DLBCL	2–15.2	15.2	15.2
37	MZL	3.4–6.2	Excised	6.2	DLBCL	9.7	9.7	9.7
38	FL 2	3.5–16.1	3.5	16.1	DLBCL	2.6–8	Excised	8
39	MZL	1.3–3.8	1.7	3.8	DLBCL	2–13.8	13.8	13.8

PET, positron emission tomography; SUV, standardized uptake value; FL, follicular lymphoma; DLBCL, diffuse large B-cell lymphoma; LCL, large-cell lymphoma; MZL, marginal zone lymphoma; MALT, mucosa-associated lymphoid tumor; UPIN, unique patient identification number.

SEGUIMIENTO

- No recomendado
- Sospecha clínica > 80%
- Bajo VPP
- Recidivas no sospechadas < 10% (***HL)

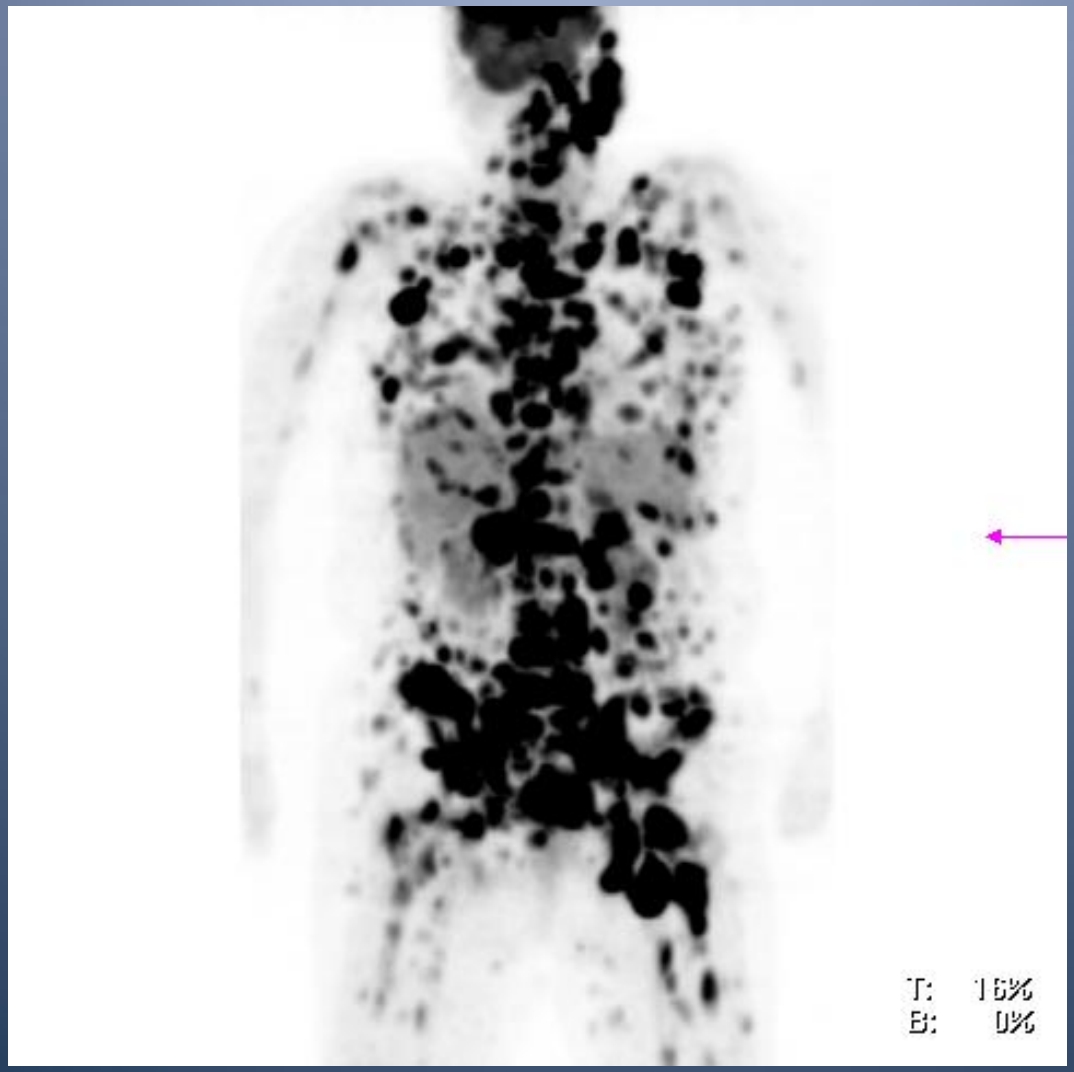
LEUCEMIA

SARCOMA MIELOIDE
SARCOMA GRANULOCÍTICO
CLOROMA

- Compromiso extramedular por LMA
- Masa extramedular compuesta por blastos mieloides fuera de la MO, destrucción tisular
- Prevalencia incierta ¿5%?
- Diagnóstico o recaída
- Mal pronóstico
- Transplante MO

SINDROME DE RICHTER

- Transformación la leucemia linfática crónica en linfoma difuso de células grandes
- Pronóstico desfavorable
- Sens 91%, Esp 80% y VPN 97%
- Guiar Biopsia

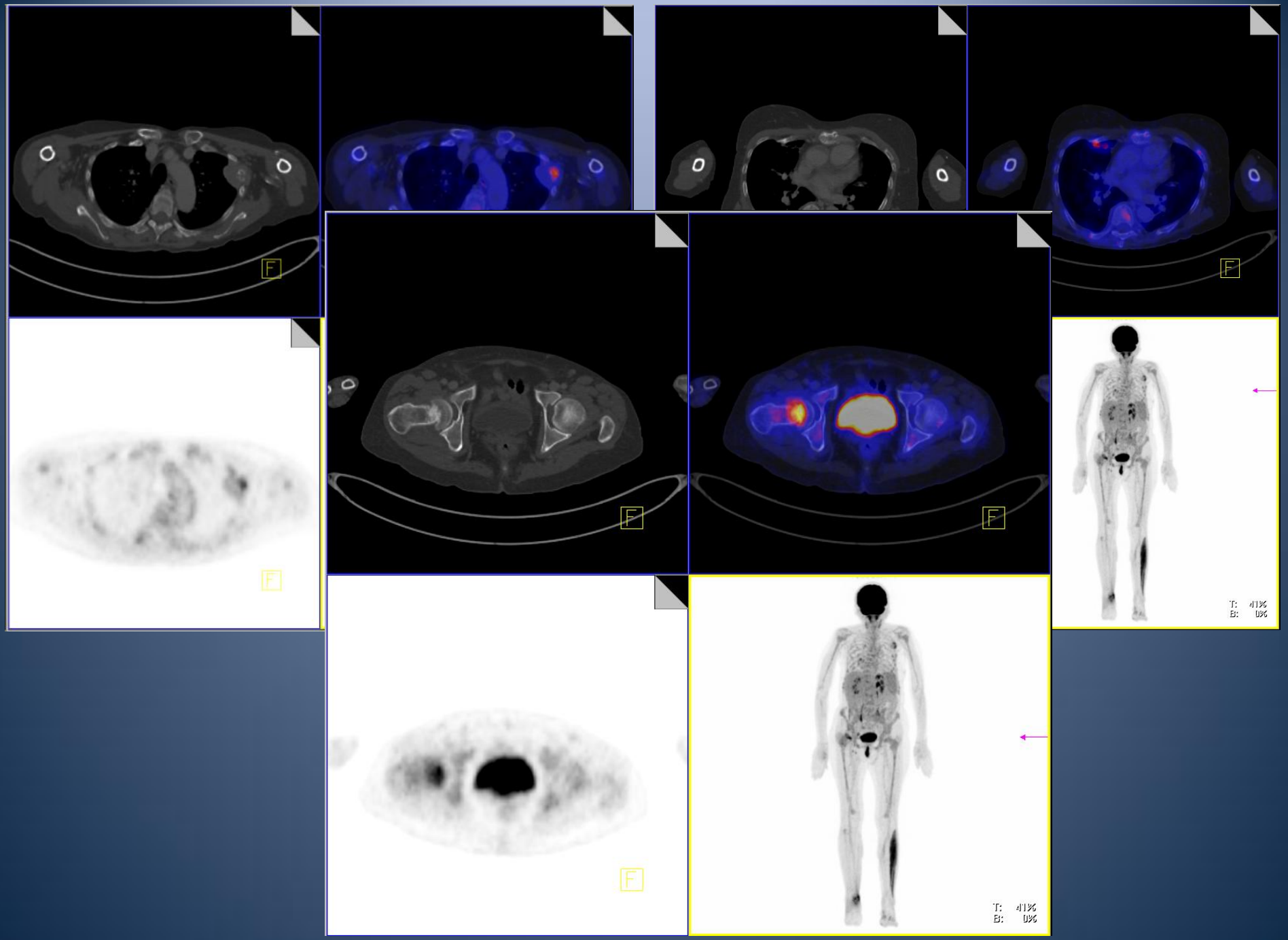

T: 16%
B: 0%

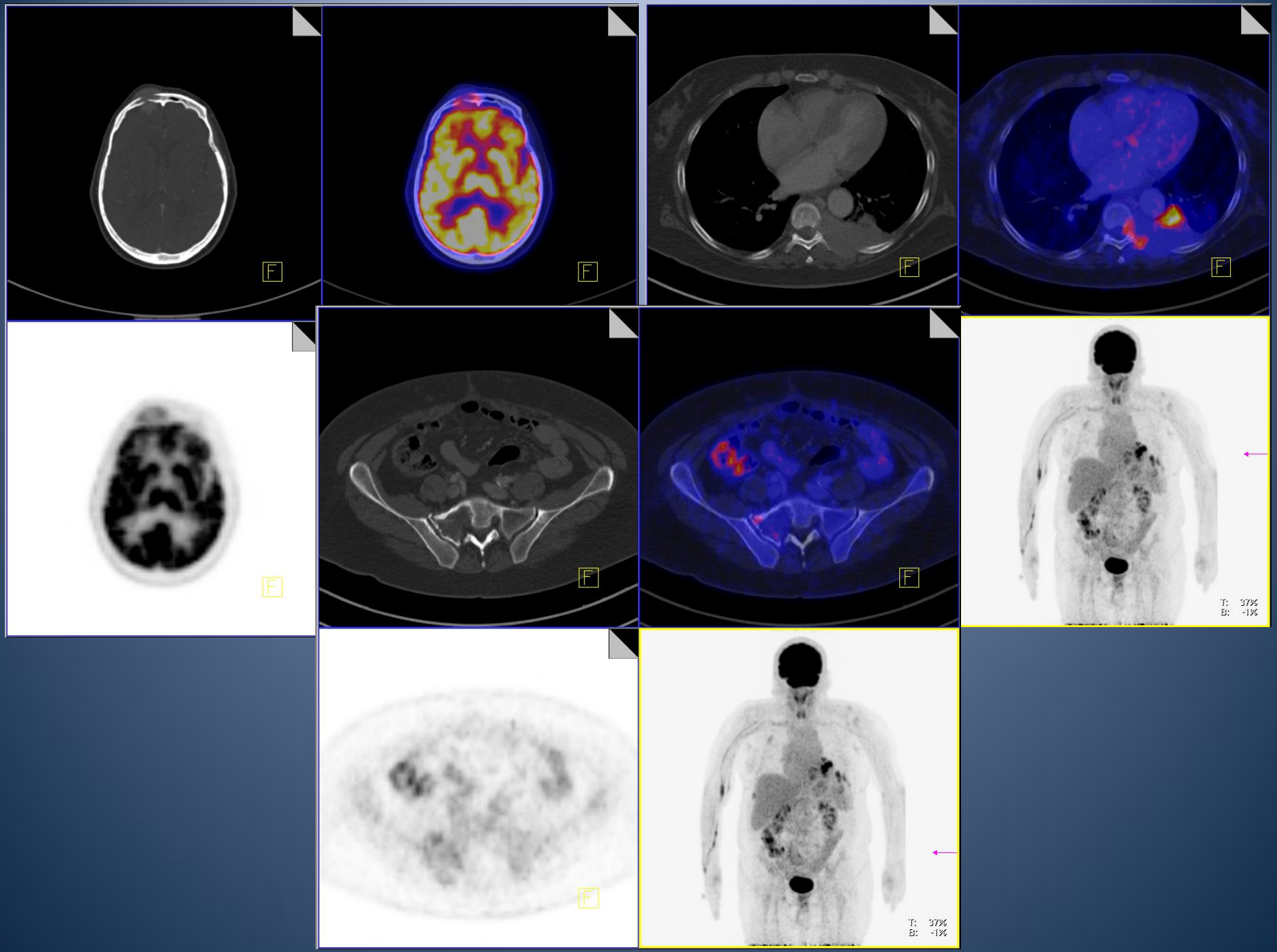
MIELOMA

ETAPIFICACION

- Mayor Sens y Esp que cualquier otra técnica de imágenes
- Compromiso extra-oseo
- Cambio en conducta terapéutica en > 45%
- Valor pronóstico

- Control tratamiento


F
T: 41%
B: 0%

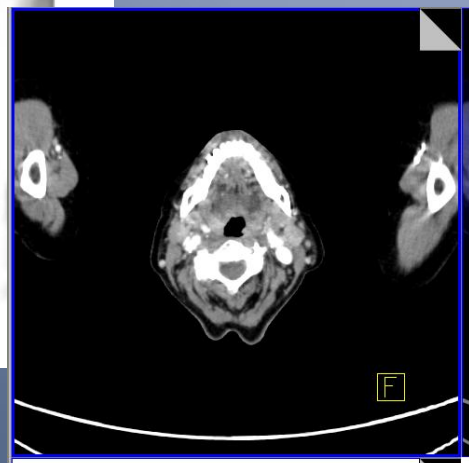


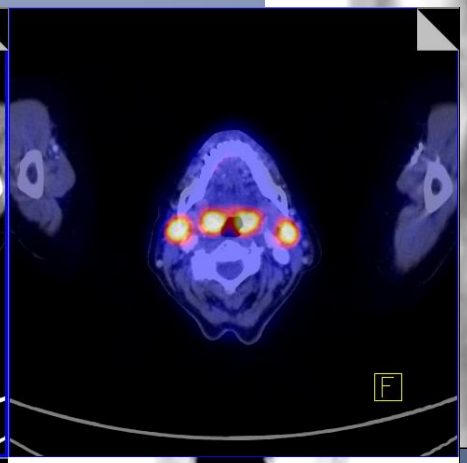
CONCLUSIONES

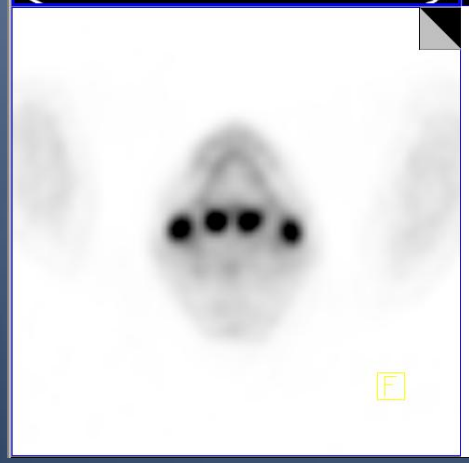
PITFALLS FDG PET/CT

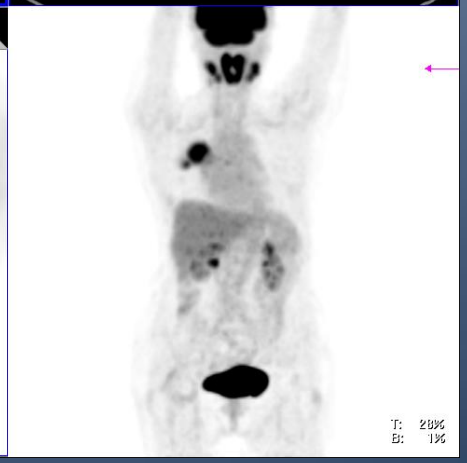
- FALSOS NEGATIVOS: QT reciente, corticoides, volumen enfermedad menor a resolución equipo
- FALSOS POSITIVOS: INFLAMACION

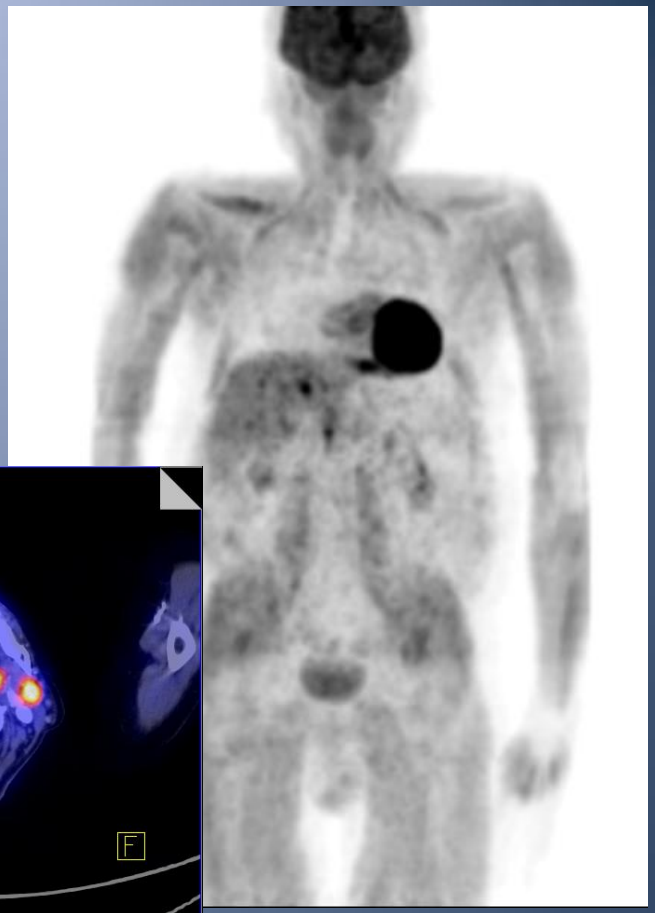
- GRASA PARDA
- INSUFICIENTE AYUNO
- USO INSULINA
- HIPERPLASIA TIMICA
- EJERCICIO

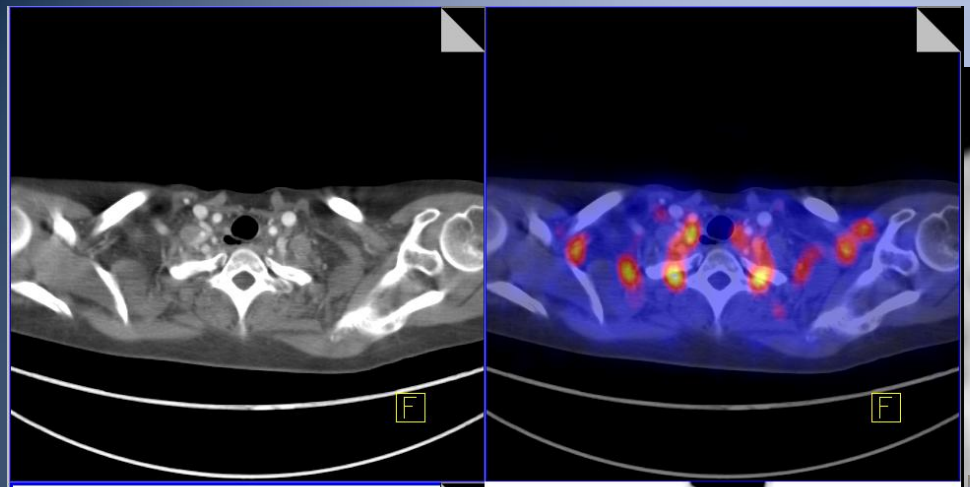

F

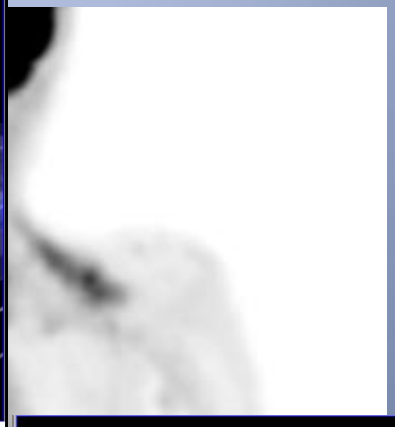
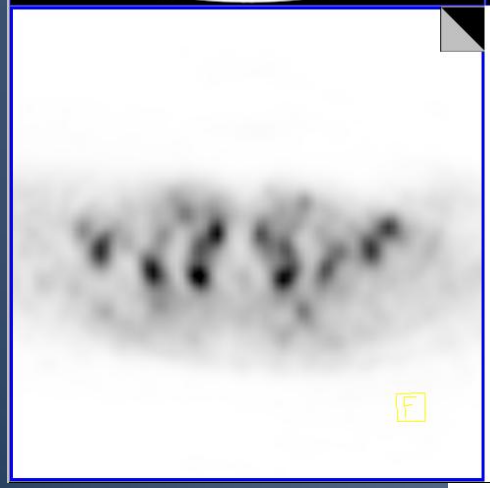

F

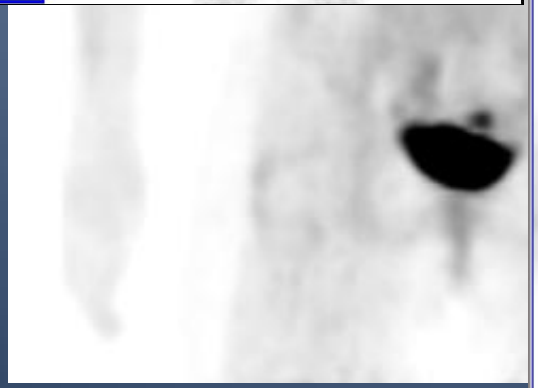
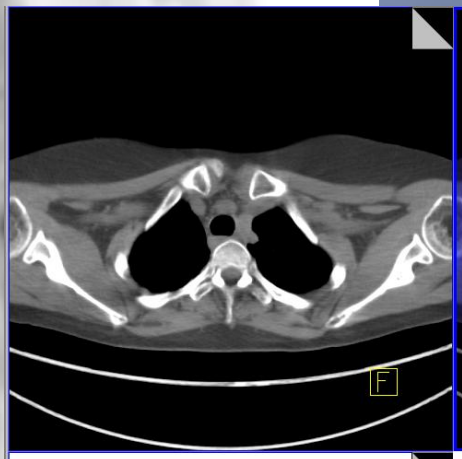
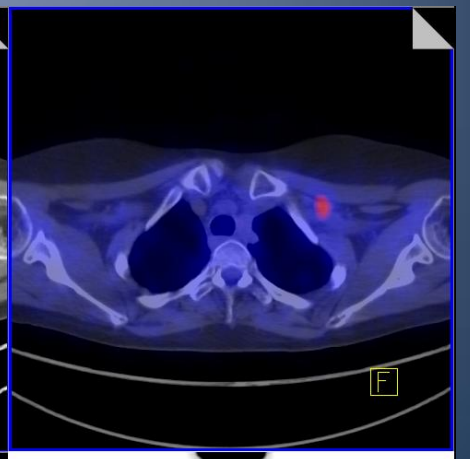

F

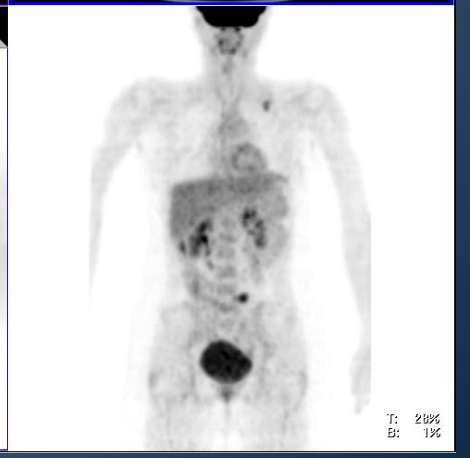

T: 20%
B: 1%

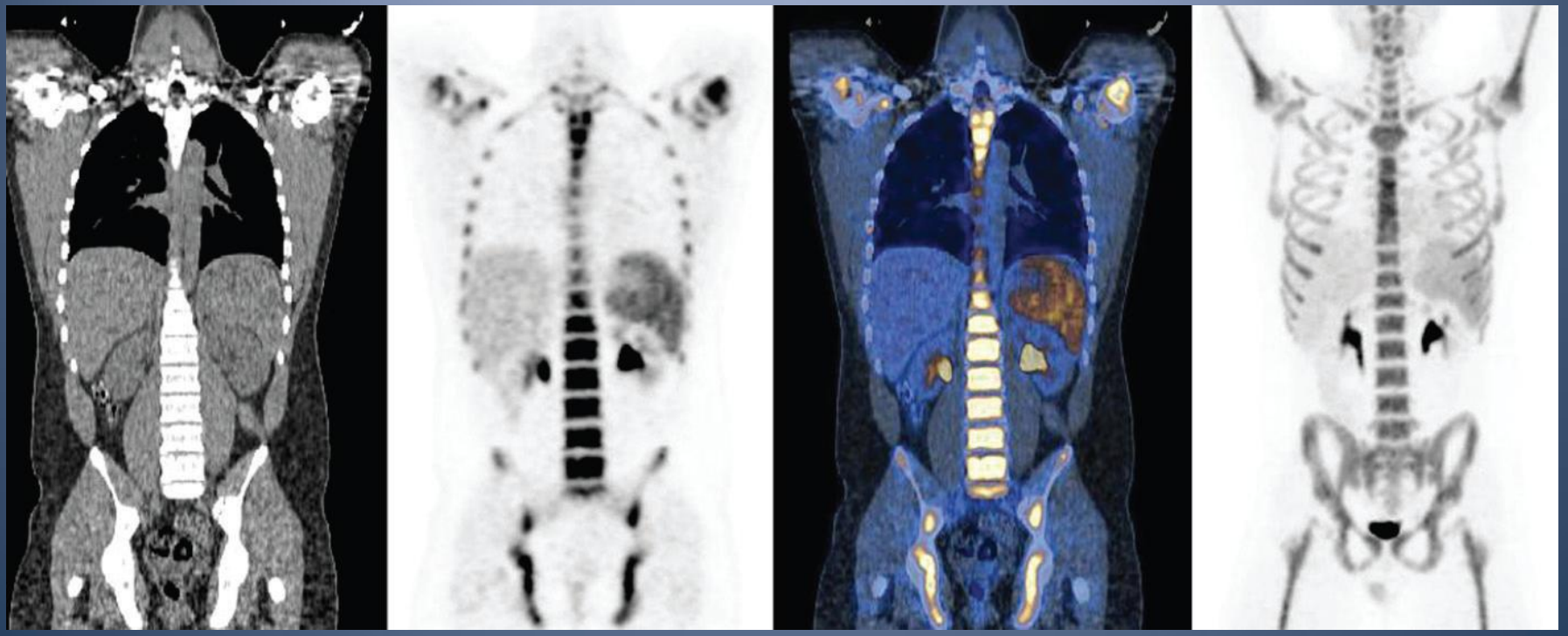




T: 21%
B: 1%





T: 28%
B: 1%



PREPARACION PACIENTES

Table 6. Guidelines for Conduct of FDG-PET Scans

Parameter	Recommendations
Patient preparation	Fast overnight, or at least 6 hours Hydrate with > 500 mL post-FDG injection Mild sedation as needed
Blood glucose	Not to exceed 200 mg/dL
Patient imaging	60 ± 10 minutes after FDG injection
Timing of PET scan	Pretreatment scans required if post-treatment to be performed, within 2 weeks of therapy Post-treatment scans at least 6-8 weeks after chemo(immuno)therapy
FDG dose	3.5-8 MBq/kg body weight, minimum 185 MBq
Acquisition	Base of skull to mid-thigh unless other areas of concern

NOTE. Adapted from Juweid et al.[99]
Abbreviations: FDG, flurodeoxyglucose; PET, positron emission tomography.

1 litro agua

150 mg/dl

Sin metformina

Sin insulina

MISMO EQUIPO!!!

3 meses post RT

ANTECEDENTES CLINICOS!!!!!

Role of Functional Imaging in the Management of Lymphoma

Bruce D. Cheson

A B S T R A C T

18-F-fluorodeoxyglucose (FDG) –positron emission tomography (PET), and more recently PET/computed tomography (CT), is the most sensitive and specific imaging technique currently available for patients with lymphoma. Nevertheless, despite being increasingly used in pretreatment assessment, midtreatment evaluation of response, post-treatment restaging, and surveillance during follow-up of patients with lymphoma, its impact on clinical outcome in most clinical situations remains to be confirmed. PET/CT provides its greatest clinical benefit in the post-treatment evaluation of Hodgkin's lymphoma and diffuse large
of metabolic imaging in other indications and in other histo
Ongoing risk-adapted studies will hopefully provide evidence
of altering treatment as a result of interim PET results. Effo
the conduct and interpretation of FDG-PET scans. FDG-
lymphoma patient management; however, its usefulness
therapy, and clinical setting.

J Clin Oncol 29:1844-1854. © 2011 by American Society of

Table 7. Recommendations for PET (PET/CT) Scans in Lymphoma Clinical Trials

Histology	Pretreatment	Midtreatment	Response Assessment	Post-Therapy Surveillance
DLBCL	Yes*	Clinical trial	Yes	No
HL	Yes*	Clinical trial	Yes	No
Follicular NHL	No†	Clinical trial	No†	No
MCL	No†	Clinical trial	No†	No
Other aggressive NHLs	No†	Clinical trial	No†‡	No
Other indolent NHLs	No†	Clinical trial	No†‡	No

NOTE. Adapted from Cheson et al.[11]
Abbreviations: PET, positron emission tomography; CT, computed tomography; DLBCL, diffuse large B-cell lymphoma; HL, Hodgkin's lymphoma; NHL, non-Hodgkin's lymphoma; MCL, mantle-cell lymphoma.
*Strongly recommended.
†Only if response is a primary study end point.
‡Only if PET positive pretreatment.