

Abstract 590.

Alternative methods of PET-CT interpretation :
Can we improve mediastinal staging ?

M. Evison, P. Crosbie, J Martin, P. Barber, R. Booton.

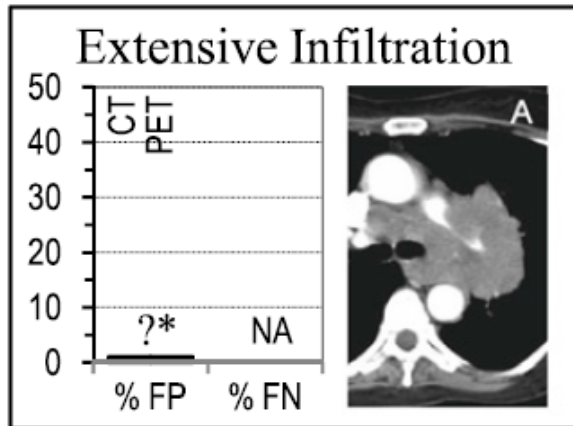
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Disclosure slide

- **I have no relevant financial relationships to disclose.**

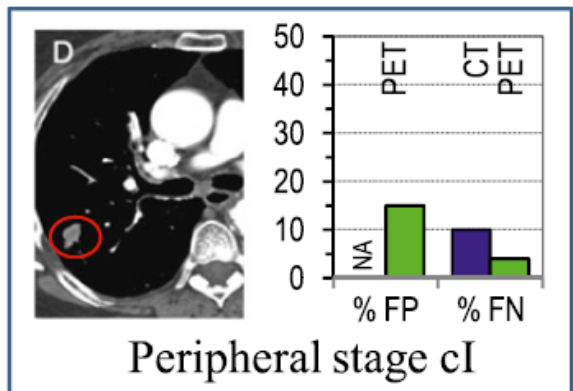
Nodal staging NSCLC.

A
C
C
P
A

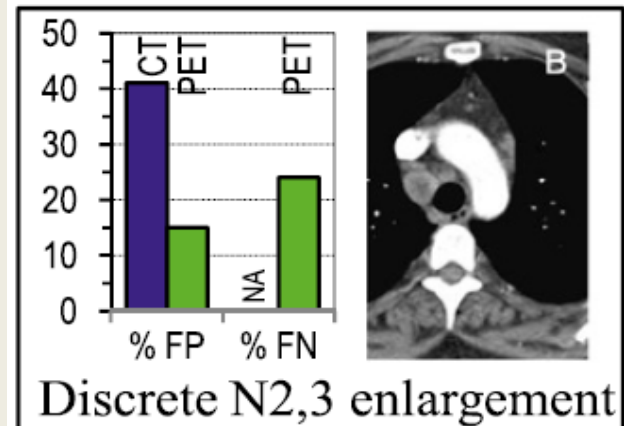


No tissue confirmation needed based on PET-CT

A
C
C
P
D

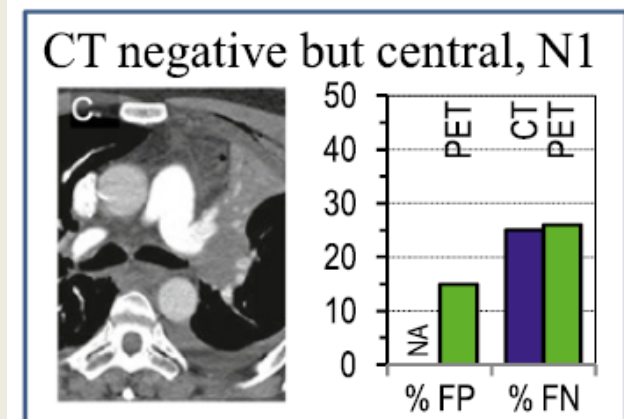


A
C
C
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B



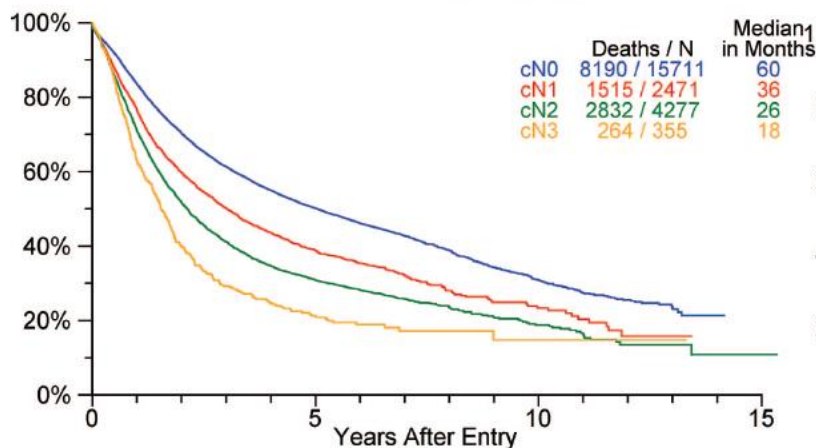
Tissue confirmation needed : E(B)US +/- surgical

A
C
C
P
C

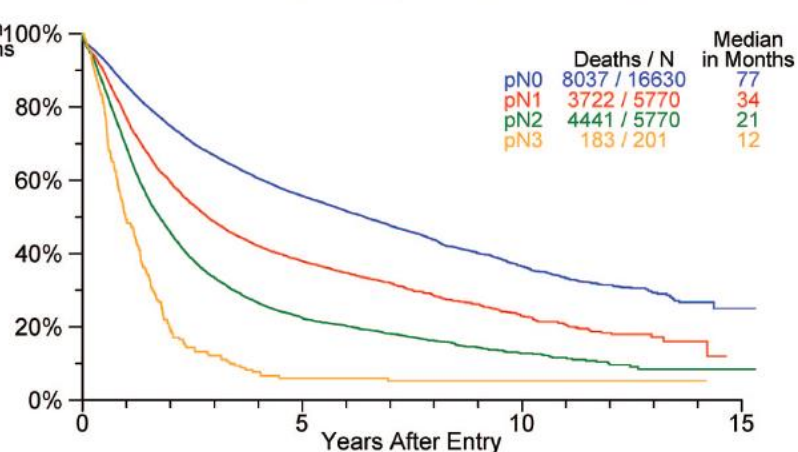


Nodal staging NSCLC.

Clinical Staged, By cN



Pathologically Staged, By pN

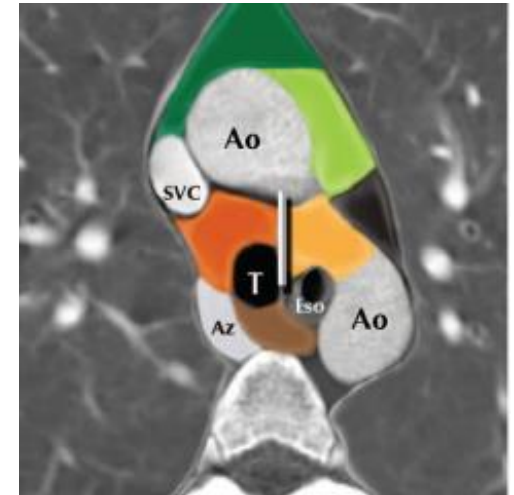


	1 Yr	5 Yrs		HR	P
cN0	84%	50%			
cN1	77%	39%	vs cN0:	1.37	<.0001
cN2	71%	31%	vs cN1:	1.24	<.0001
cN3	63%	21%	vs cN2:	1.31	<.0001

	1 Yr	5 Yrs		HR	P
pN0	86%	56%			
pN1	77%	38%	vs pN0:	1.63	<.0001
pN2	69%	22%	vs pN1:	1.51	<.0001
pN3	49%	6%	vs pN2:	1.81	<.0001

Nodal staging NSCLC.

- **Computed Tomography**
 - has been the standard method for years
 - demonstrates lymph node enlargement
 - short axis $\geq 10\text{mm}$ = suspect
 - **sensitivity 60%** and specificity 80%
 - defines ACCP groups = need for tissue
 - anatomical borders = station allocation



Rusch V, et al. J Thorac Oncol 2009.

Nodal staging NSCLC.

- Integrated PET-CT for mediastinal nodal staging

TABLE 1. Main Characteristics of All Studies Included in the Meta-analysis

ID	Design	Patients	TP	FP	FN	TN	SEN %	SPE %	Verification Criteria	Analysis Unit	Diagnostic Criteria
Tasci et al. ¹³	Retrospective	127	17 (31)	19 (32)	2 (12)	89 (531)	88.8 (72)	81.6 (94.7)	1, 2, 4	Patient (MLN)	maxSUV >5.2
Li et al. ¹⁴	Retrospective	158	41	12	8	97	83.7	89	1, 2	Patient	maxSUV >2.5
Sit et al. ¹⁵	Retrospective	107	15	18	14	110	52	86	1, 2, 3	MLN	maxSUV >2.5
Hwangbo et al. ¹⁶	Prospective	117	21	35	9	52	70	59.8	1, 4	Patient	maxSUV >2.5
Bille et al. ¹⁷	Retrospective	159	14 (22)	7 (9)	17 (24)	121 (631)	45.2 (47.8)	94.5 (98.6)	1, 2	Patient (MLN)	Visually
Perigaud et al. ¹⁸	Prospective	51	4	6	6	35	40	85	1	Patient	maxSUV >3
Sanli et al. ¹⁹	Prospective	78	9	7	2	60	81.8	89.5	1, 2, 4	Patient	maxSUV >2.5
Lee et al. ²⁰	Prospective	182	27 (35)	16 (30)	9 (18)	130 (695)	75 (66)	89 (96)	1, 2	Patient (MLN)	Visually
Al-Sarraf et al. ²¹	Retrospective	206	48	20	53	842	47.5	97.7	1, 2, 3	Node	maxSUV >2.5
Yang et al. ²²	Retrospective	122	18 (132)	11 (73)	7 (21)	86 (413)	72 (86)	89 (85)	1	Patient (MLN)	Visually
Hu et al. ²³	Prospective	46	117	72	17	378	87.3	84	1	Node	maxSUV >2.5
Kim et al. ²⁴	Prospective	674	110 (126)	21 (48)	70 (149)	473 (2154)	61 (46)	96 (98)	1, 2	Patient (MLN)	Visually
Lee et al. ²⁵	Retrospective	126	24	19	4	79	85.7	80.6	1, 2, 3	Patient	Visually
Bryant et al. ²⁶	Prospective	397	131 (120)	33 (67)	12 (34)	195 (1031)	91.6 (77.9)	85.5 (93.9)	1, 2, 4	Patient (MLN)	maxSUV >2.5

TP, true-positive; FP, false-positive; TN, true-negative; FN, false-negative; SEN, sensitivity; SPE, specificity; 1, thoracotomy; 2, mediastinoscopy; 3, mediastinotomy; 4, VATS, video-assisted thoracoscopic surgery; MLN, mediastinal lymph nodes; maxSUV MAX, maximum standardized uptake value.

Lv, et al. J Thorac Oncol 2011;6:1350.

Nodal staging NSCLC.

Meta-analysis integrated PET/CT

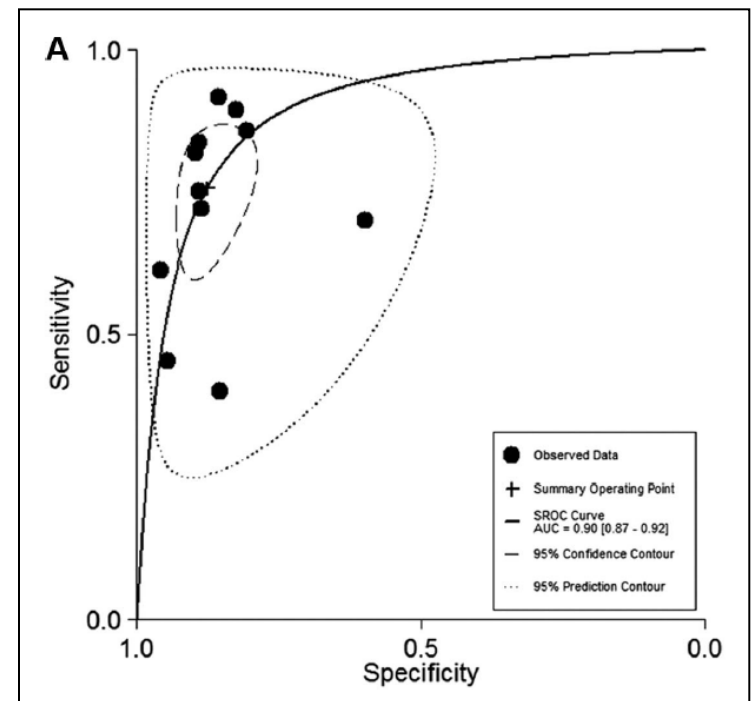
Pooled weighted Sens. 76%

Pooled weighted Spec. 88%

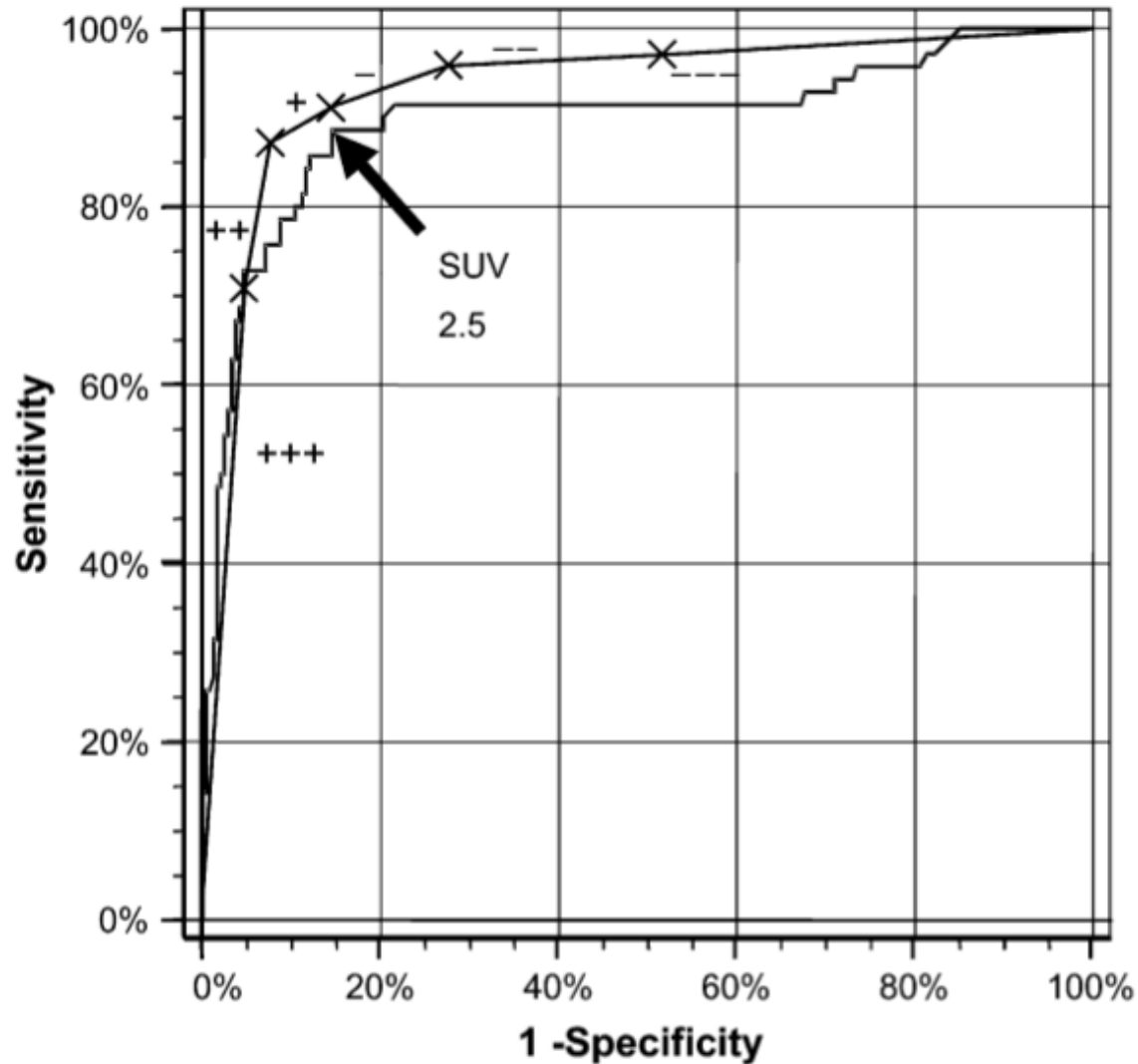
Overall NLR = 0.28 and PLR = 6.1

AUC = 90 %

Diagnostic OR = 22



Lv, et al. J Thorac Oncol 2011;6:1350.



Hellwig, et al. J Nucl Med 2007;48:1761.

author	prev Ca LNs	SUV	cut-off	ROC	sens	spec
Bryant	36%	SUVmax	5.3	0.85	0.91	0.88
Cerfolio	78%	ratio SUV LN/Tu	0.56	0.79	0.94	0.72
Tournoy	36%	SUVmax	2.9	0.86	0.76	0.90
		ratio SUV LN/ <i>liver</i>	1.5	0.89	0.82	0.93
Iskender	11%	SUVmax	2.75	na	0.82	0.88
		ratio SUV LN/Tu	0.49	0.69	0.70	0.65
Kuo	18%	SUVmax	3.2	0.67	0.57	0.74
		ratio SUV LN/ <i>aorta</i>	1.37	0.69	0.86	0.51
		Ratio SUV LN/ <i>liver</i>	1.02	0.72	0.71	0.62
Evison	63%	SUVmax	4	0.88	0.91	0.88
		ratio SUV LN/Tu	0.40	0.93	0.91	0.86

Alternative PET-CT interpretation methods

	Visually	SUV 4.0	Ratio 40%
sensitivity	?	90	91
specificity	?	90	87
NPV	?	86	86
PPV	?	93	91

How does PET really perform ? Denominator ?

All patients had lung cancer.

Not all CT or PET negative nodes were sampled.

Not all CT or PET + nodes with - EBUS were verified.

How does PET perform on a patient basis ?

Alternative PET-CT interpretation methods

Conclusions : SUVmax and/or Ratio LN/Tu

1. do not replace pathological staging :

INDEED

2. may be relevant following a negative EBUS :

?

Mediastinoscopy vs Endosonography for Mediastinal Nodal Staging of Lung Cancer

A Randomized Trial

	Surgical	ES+surgical	p-Value
Sensitivity, % (95% CI)	79 (66-88)	94 (85-98)	0.02
NPV, % (95% CI)	86 (76-92)	93 (84-97)	0.18

1. Initial mediastinal evaluation by endosonography (EUS/EBUS).
→ reduces need for surgical staging by 50-70%
2. Negative endosonography should be followed by mediastinoscopy.
→ 11 mediastinoscopies to detect 1 additional N2

Risk stratification

	0	1	2
Echogenicity	Homogeneous		Heterogeneous
SUV	<4	>4	
SUV ratio %	<40	41-60	>60

Can sonographic characteristics during EBUS-TBNA predict lymph node metastases in lung cancer? A prospective observational study

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MANCHESTER 2024
The University of Manchester

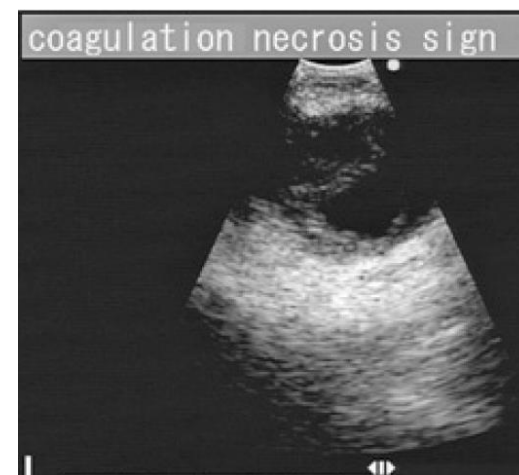
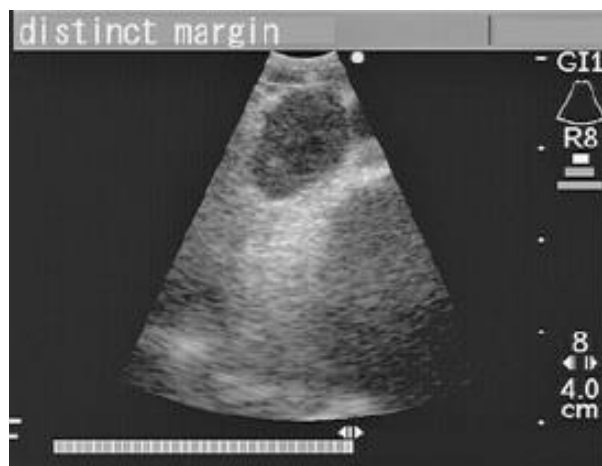
Predictors of malignancy ?

1. B-mode = morphologic features
2. Doppler-mode = vascular structures
3. Elastography = tissue elasticity or 'virtual palpation'

- Which CT and PET negative lymph nodes should be biopsied based on ultrasonography ?
- Which CT and/or PET positive LNs, which resulted in a negative NA cytology, still require a confirmatory mediastinoscopy ?

1. B-mode = morphologic features

Morphologic Category	Hazard Ratio	95% CI	P Value
Size (> 10 mm/< 10 mm)	1.34	0.882-2.03	.171
Shape (round/oval)	3.1	1.79-5.36	<.0001
Margin (distinct/indistinct)	3.05	1.61-5.75	.0006
Echogenicity (heterogeneous/homogeneous)	1.96	1.12-3.40	.0176
Central hilar structure (absence/presence)	1.34	0.793-2.25	.278
Coagulation necrosis sign (presence/absence)	5.64	3.40-9.38	<.0001

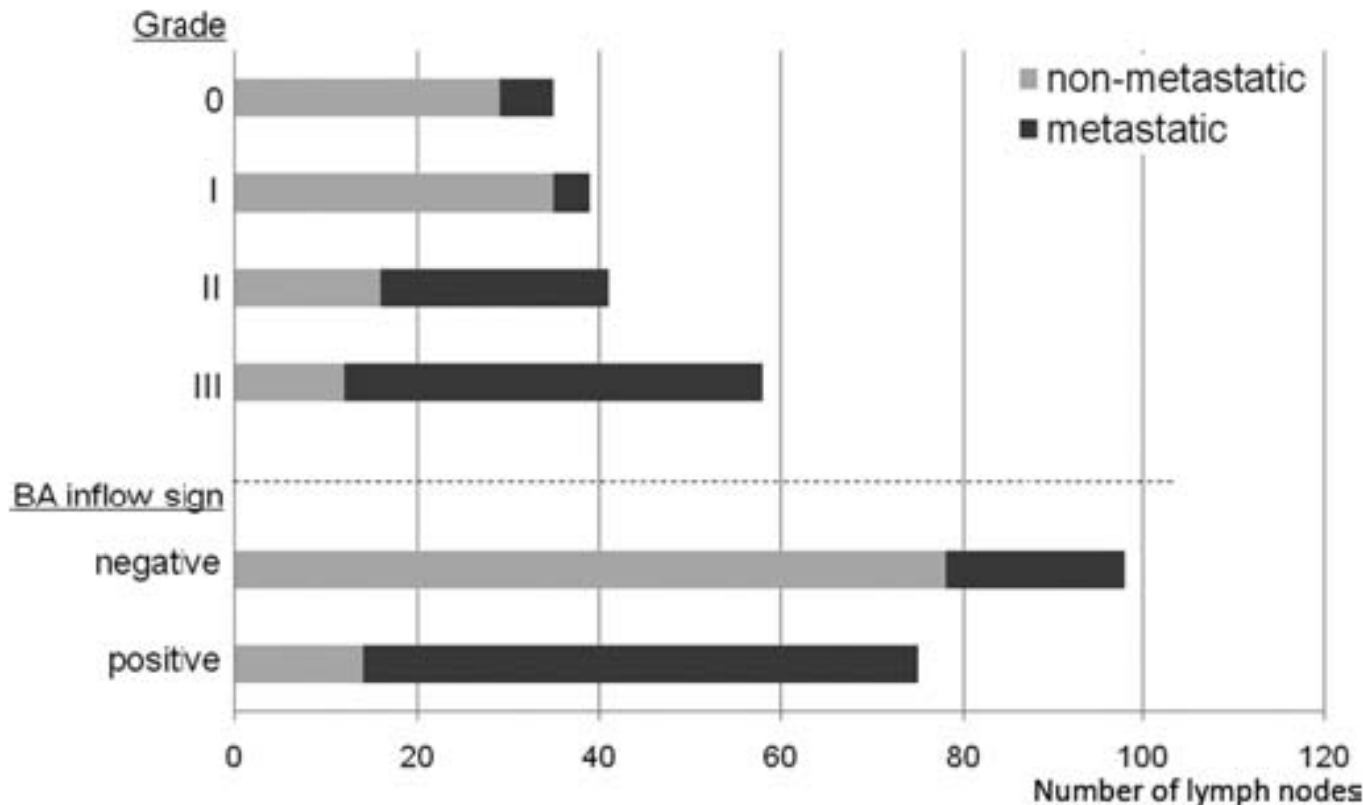


1. B-mode = morphologic features

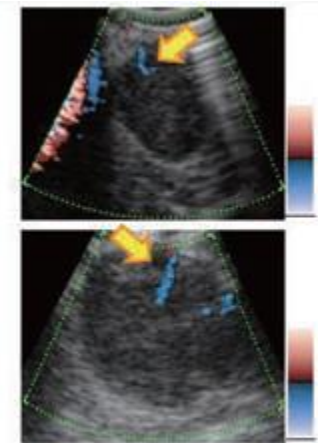
Table 4—ORs Describing the Risk of Malignancy by Nodal Characteristics

EBUS Pathology	Predictor	Variable	OR (95% CI)	P Value
Radiographic characteristics	PET scan activity	Normal	Ref	...
		Increased	3.48 (1.40-8.64)	.0072 ^a
	CT scan lymph node size	< 10 mm	Ref	...
		10-20 mm	2.89 (1.11-7.52)	.029 ^a
Ultrasound characteristics	Size	> 20 mm	34.38 (6.02-196.48)	< .0001 ^a
		Continuous: change of 5 mm	1.57 (1.23-1.99)	.0002 ^a
		< 10 mm	Ref	...
		10-20 mm	3.39 (1.77-6.46)	.0002 ^a
	Shape	> 20 mm	10.28 (4.31-24.50)	< .0001 ^a
		Triangular	Ref	...
		Oval	3.50 (1.54-7.96)	.0028 ^a
		Round	4.16 (1.67-10.36)	.0022 ^a
	Echogenicity	Draping	1.49 (0.46-4.89)	.51
		Hyperechoic	Ref	...
		Hypoechoic	1.47 (0.51-4.30)	.48
	Borders	Isoechoic	0.61 (0.11-3.32)	.56
		Well-defined	Ref	...
		Indistinct	0.98 (0.58-1.66)	.93

2. Doppler-mode (power / color) = vascular structures




flow



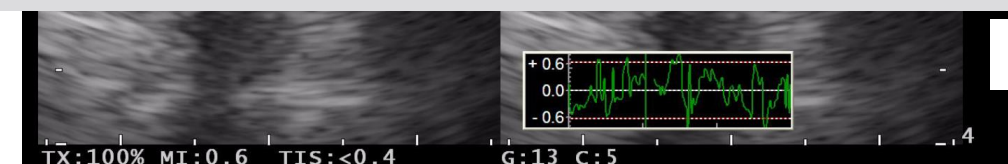
(E) BA inflow sign

3. Elastography = tissue elasticity or 'virtual palpation'



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Patient	Lymph node areas	Size mm/ PET SUV	Histogram analysis		TBNA histology	Final case diagnosis
			Mean deformation [#]	Hard areas %		
1	4R	16/10.4	55	71	Lymph node tissue, no malignant cells	TTF1- adenocarcinoma
	4L	14/3.7	10	98	TTF1- adenocarcinoma	
2	4R	17/3	49	81	TTF1+ adenocarcinoma	TTF1+ adenocarcinoma
3	2R	13/2.1	167	6	Lymph node tissue, no malignant cells	Lymph nodes considered to be malignant on PET and CT, and a history of adenocarcinoma
	4R	13/2.9	67	64	Lymph node tissue, no malignant cells	



Trosini-Désert, et al. Eur Respir J 2013;41:477.

Alternative PET-CT interpretation methods

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UNDER INVESTIGATION

Thank you for your attention !

26-29 March 2014, Geneva, Switzerland

Organisers

