Actualités en IRM thoracique

Damien Mandry

Principes physiques

- **Champ magnétique** intense
  - 1.5 Tesla <-> 30000 x champ magnétique terrestre
  - D'où les CI
- **3 grandeurs** caractérisent les tissus biologiques
  - Densité de protons
  - T1
  - T2 (env. 10x plus court que le T1)
- **Pondération** d'une séquence <-> privilégier l'une de ces grandeurs

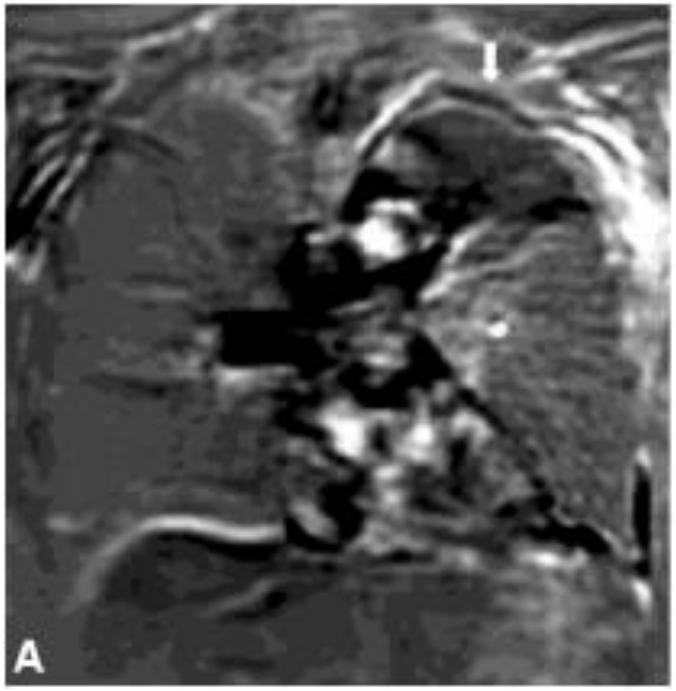
  => distinction des ≠ tissus (**caractérisation** lésionnelle)

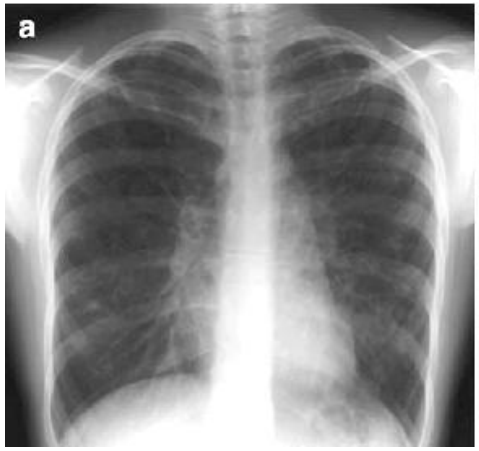
IRM : perfusion

- Séquences en EG T1 après injection de chélate de Gd
  - Eichinger M et al. Contrast-enhanced 3D MRI of lung perfusion in children with cystic fibrosis. Eur Radiol 2006; 116:2147-2152

IRM : ventilation

- Jakob PM et al. Assessment of human pulmonary function using oxygen-enhanced T1 imaging in patients with cystic fibrosis. Magn Reson Med 2004; 51:1009-1016
- McMahon CJ et al. Hyperpolarized (3)helium magnetic resonance ventilation imaging of the lung in cystic fibrosis: comparison with HRCT and spirometry. Eur Radiol 2006
- Van Beek EJR et al. Assessment of lung disease in childen with cystic fibrosis using hyperpolarized 3-He MRI: comparison with Shwachman score, Chrispin-Norman score and spirometry. Eur Radiol 2006

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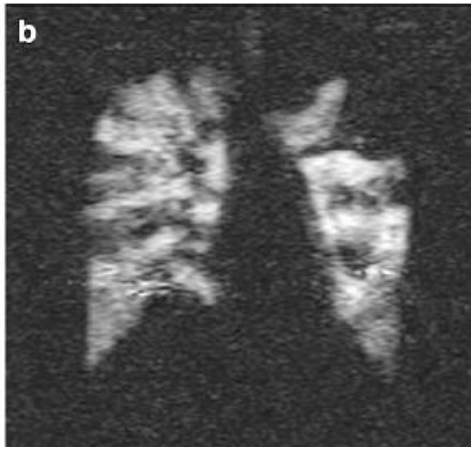
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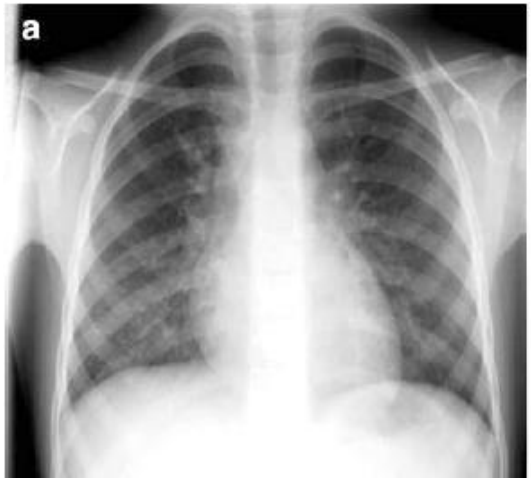
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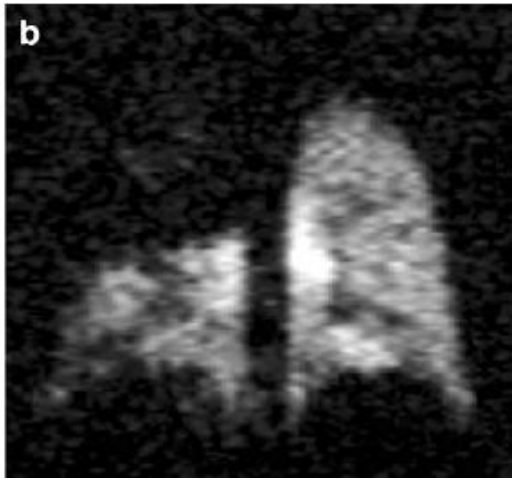
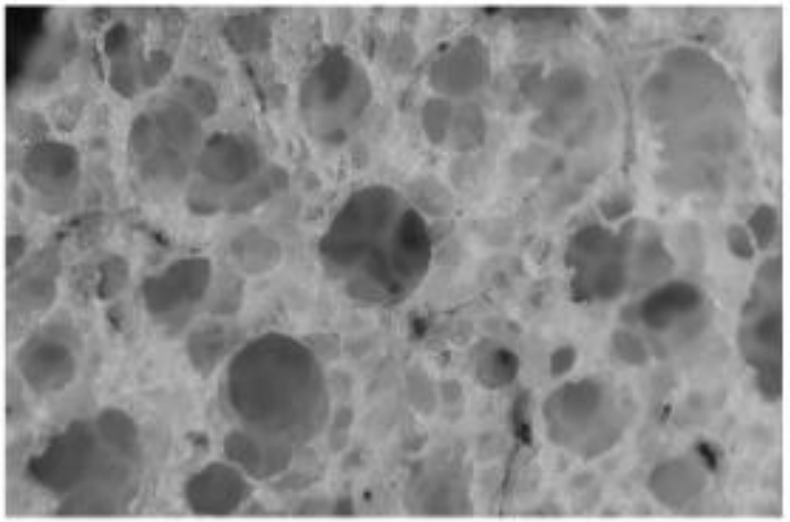

b


a


b

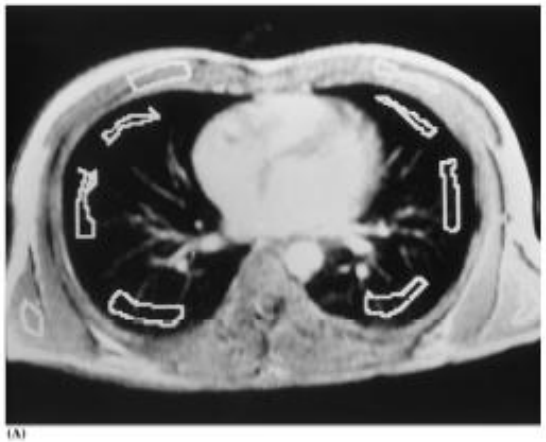
Evaluation du parenchyme

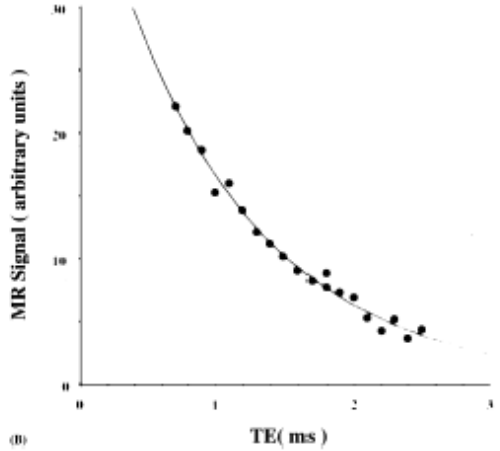
- Physiologie pulmonaire :
  - Contient environ 300 millions d'alvéoles
  - Mesurant 200 à 300 µm de diamètre
  - Et représentant une surface globale de 50 à 70 m2
  - Densité moyenne
    - 0,3 g/mL en fin d'expiration
    - 0,15 g/mL en fin d'inspiration
  - Ventilation = 6 L/min au repos



Poumon et signal IRM

- Faible signal RMN
  - Architecture alvéolaire, avec de multiples interfaces air - tissu
  - Hétérogénéités +++ par susceptibilité magnétique
  - T2* très court (1,4 msec)
  - Faible densité protonique
  - Perte de signal en raison des mouvements cardiaques et respiratoires, du flux sanguin pulmonaire et de la diffusion moléculaire





T2* = 1,03 msec; densité relative de protons = 0,36

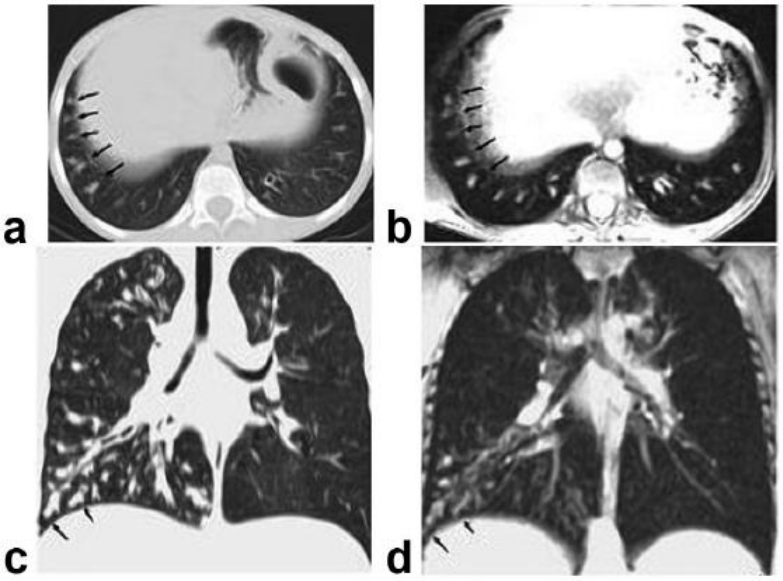
$SI=D.e^{-TE/T2^*}$

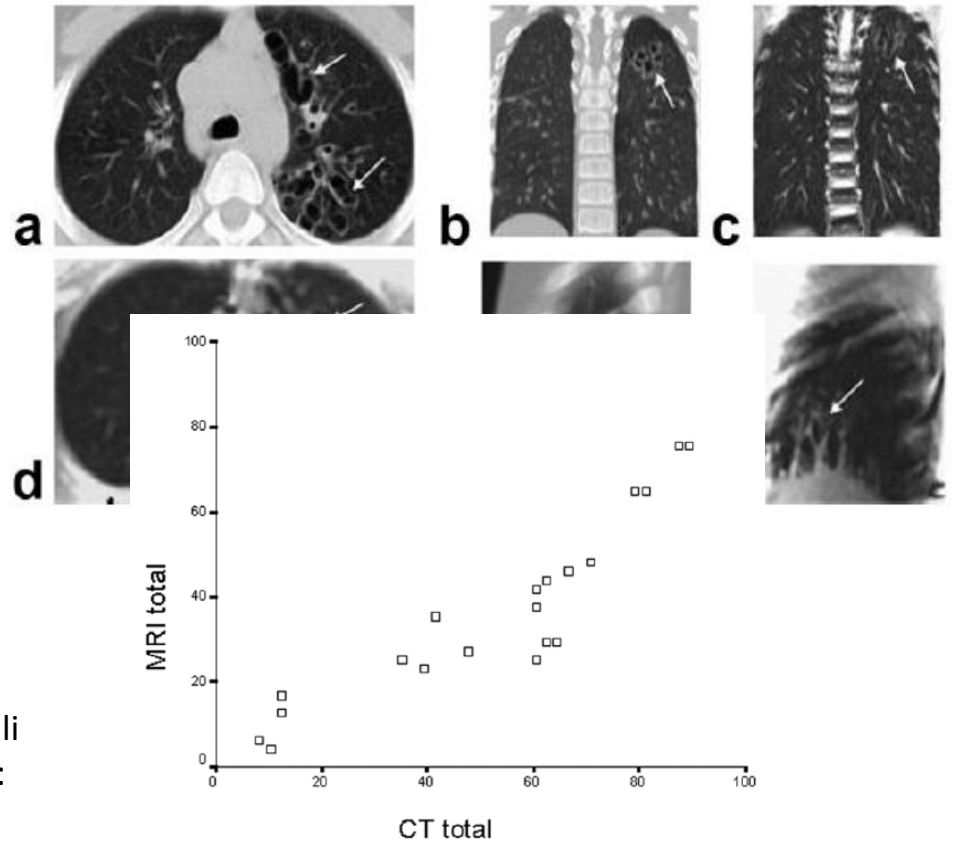
Utiliser des séquences à TE très court +++

Hatabu Eur Journal of Radiology 1999; 29:114-132

Mucoviscidose

- Motivations
  - Irradiation
    - Suivi ++
  - Distribution, étendue et importance des lésions facilitant le diagnostic

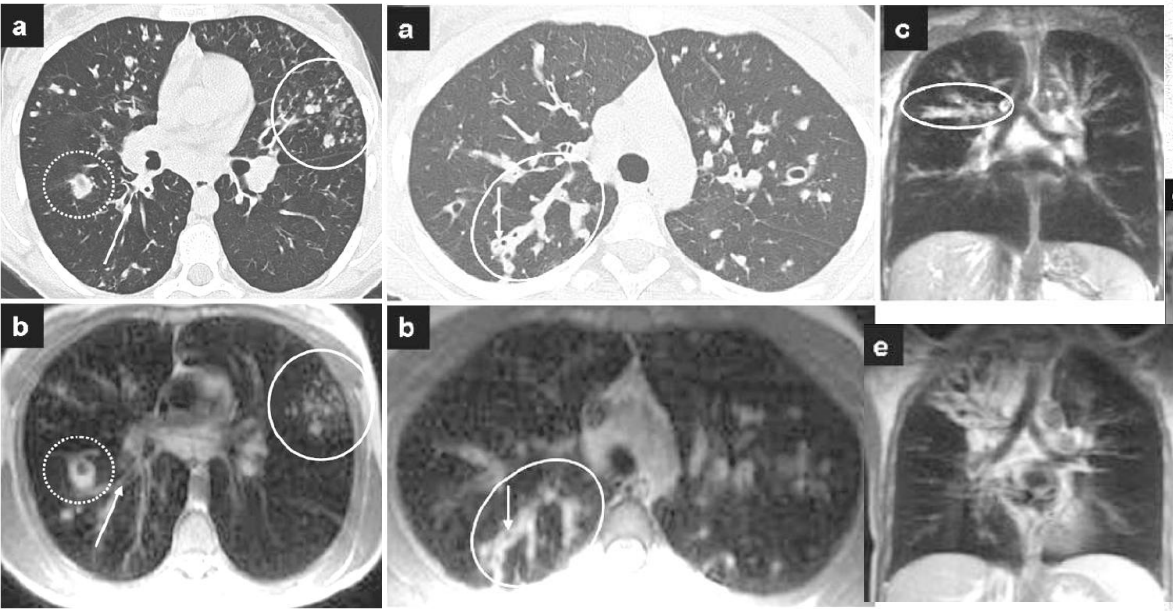


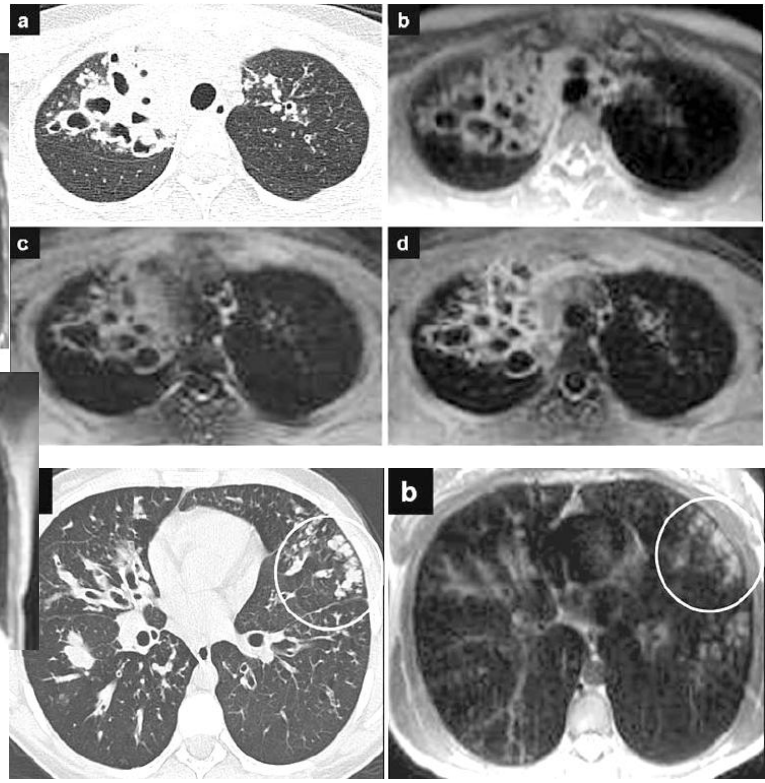


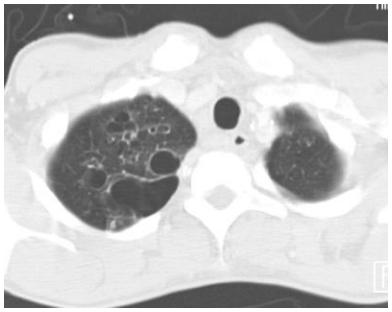
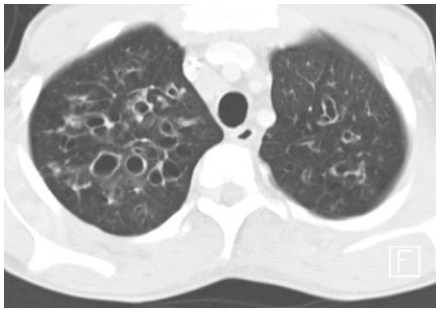
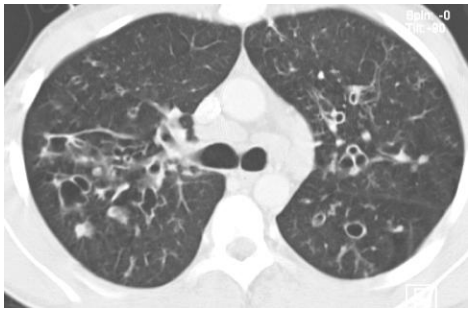
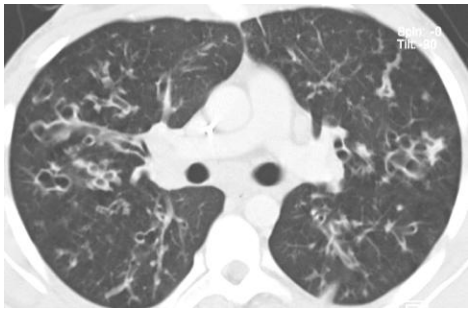
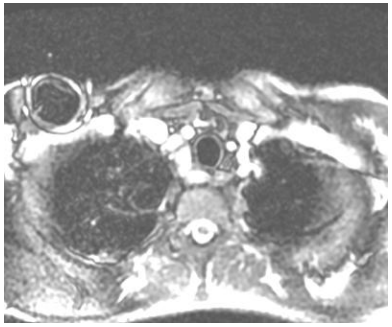
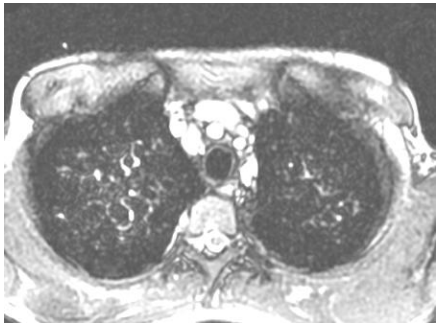
1. Failo R, Wielopolski P, Tiddens H, Hop W, Mucelli R, Lequin M. Lung morphology assessment using MRI: a robust ultra-short TR/TE 2D steady state free precession sequence used in cystic fibrosis patients. Magn Reson Med. 2009 Feb 1;61(2):299–306.

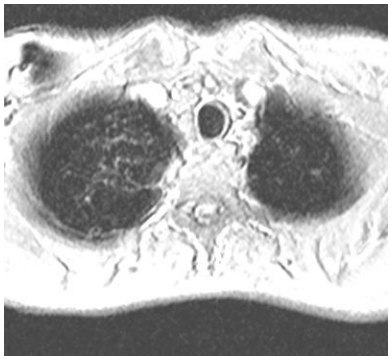
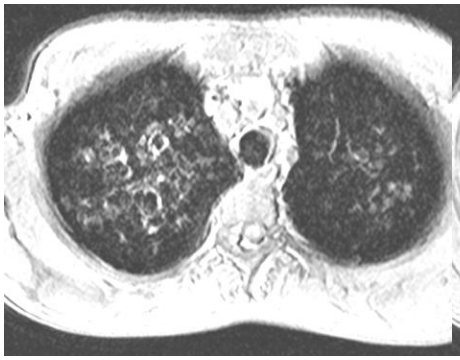
Mucoviscidose

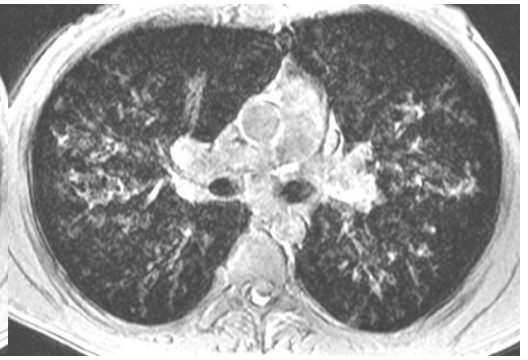
- « Comparaisons » vs CT
  - Daltro PA et al. MRI lung findings in pediatric patients with cystic fibrosis compared with CT findings. RSNA 2005
  - Hebestreit A et al. Follow-up of acute pulmonary complications in cystic fibrosis by MRI: a pilot study. Acta Paediatr 2004; 93:414-416
  - Puderbach M et al. proton MRI appearance of cystic fibrosis: comparison to CT. Eur Radiol 2006

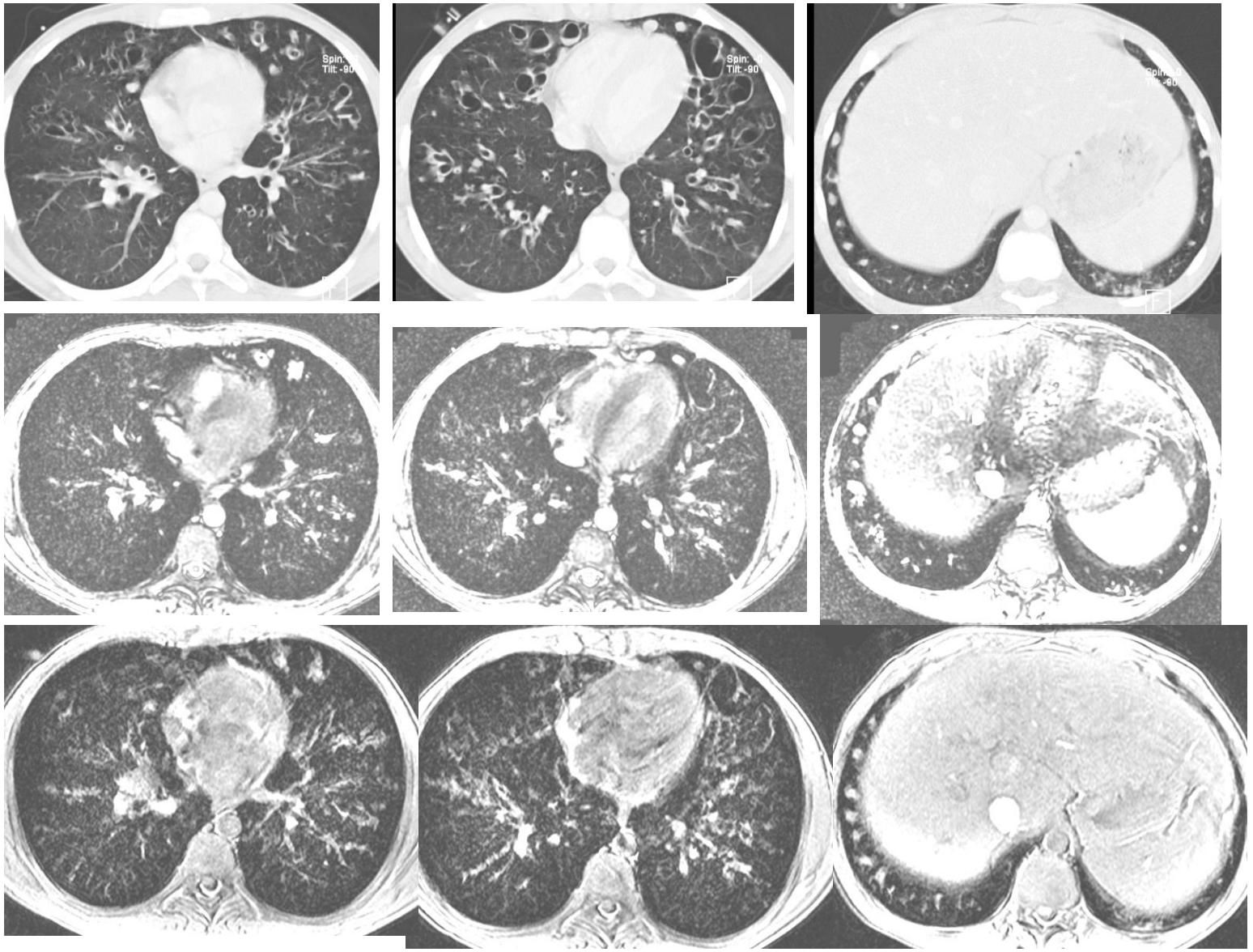




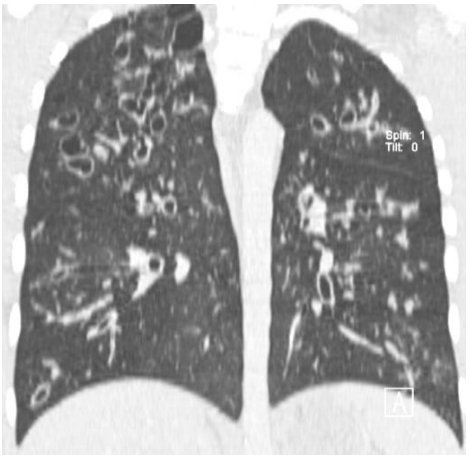












Spin: 1
Tilt: 0

Spin: 1
Tilt: 0

Spin: 1
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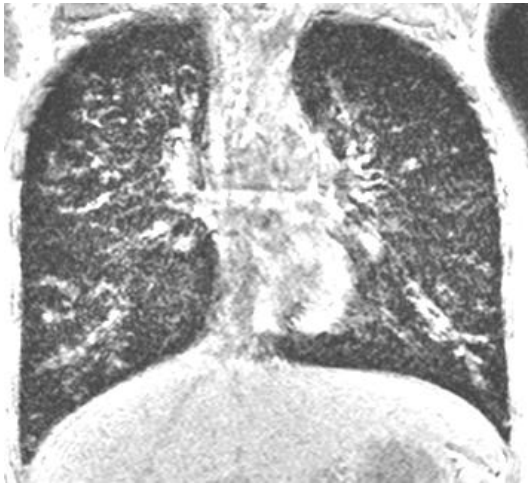
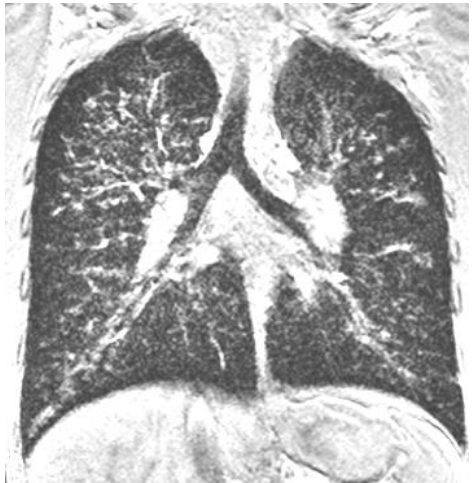




Anomalies parenchymateuses (HTAP)

Table 2

Sensitivity of MR Imaging in the Diagnosis of Various Morphologic Lung Abnormalities and Interobserver Agreement between the Two Readers for MR Imaging

Abnormality	Sensitivity (%)	No. Detected at MR imaging	No. Detected at CT	κ Value*
Pleural effusion	100	15	15	0.89
Pericardial effusion	100	12	12	0.83
Consolidation	100	2	2	0.66
Fibrosis	89	41	46	0.79
Nodules	75	9	12	0.71
Lymph nodes	71	12	17	0.65
Bronchiectasis*	67	4	6	0.61
Atelectasis	64	20	31	0.75
Mucus plugging	50	2	4	0.56
Emphysema	16	7	45	0.60
Mosaic pattern	9	3	33	0.53

* Patients without cystic fibrosis and those with traction bronchiectasis were not included.

Table 3

Overall Accuracy of MR Imaging in the Overall Diagnosis of Pulmonary Fibrosis

Fibrosis	CT Present	CT Absent	Total
MR present	41	3	44
MR absent	5	30	35
Total	46	33	79

Note.—The following values were calculated: sensitivity, 89% (95% CI: 77%, 96%); specificity, 91% (95% CI: 76%, 98%); positive predictive value, 93% (95% CI: 82%, 99%); and negative predictive value, 86% (95% CI: 70%, 95%).

1. Rajaram S, Swift AJ, Capener D, Telfer A, Davies C, Hill C, et al. Lung morphology assessment with balanced steady-state free precession MR imaging compared with CT. Radiology. 2012 May;263(2):569–77.

Figure 1

a.

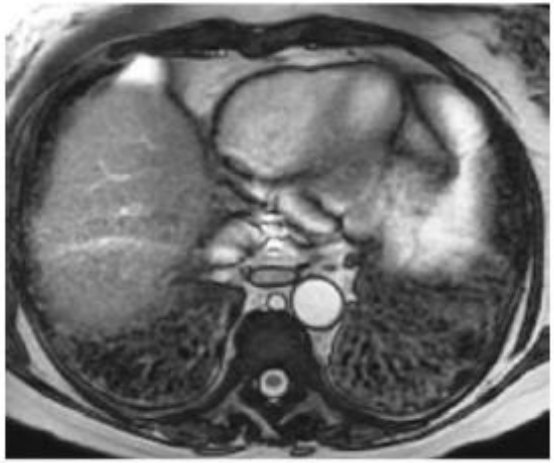
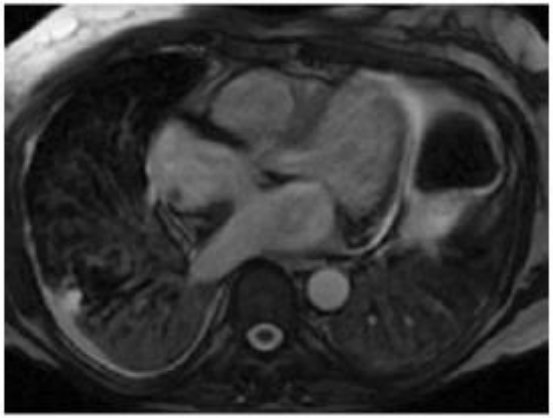


Figure 2

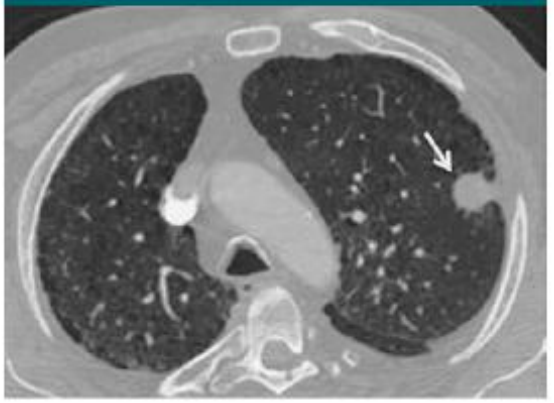
a.



b.

Figure 2: **(a)** CT and **(b)** bSSFP MR images show typical nonspecific interstitial pneumonia pattern of

Figure 3



a.

b.

Figure 3: **(a)** CT and **(b)** bSSFP MR images show a peripheral 12-mm lung nodule.

Anomalies parenchymateuses (HTAP)

Figure 4

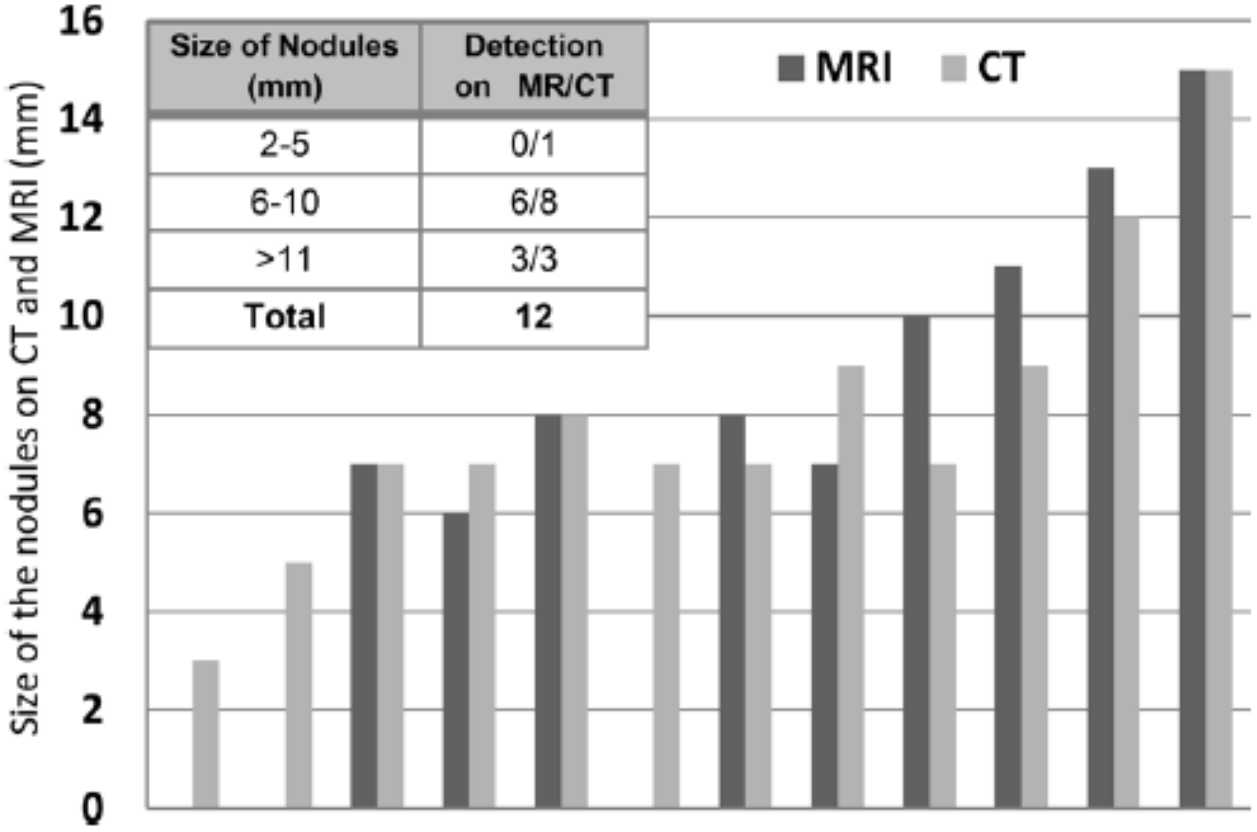
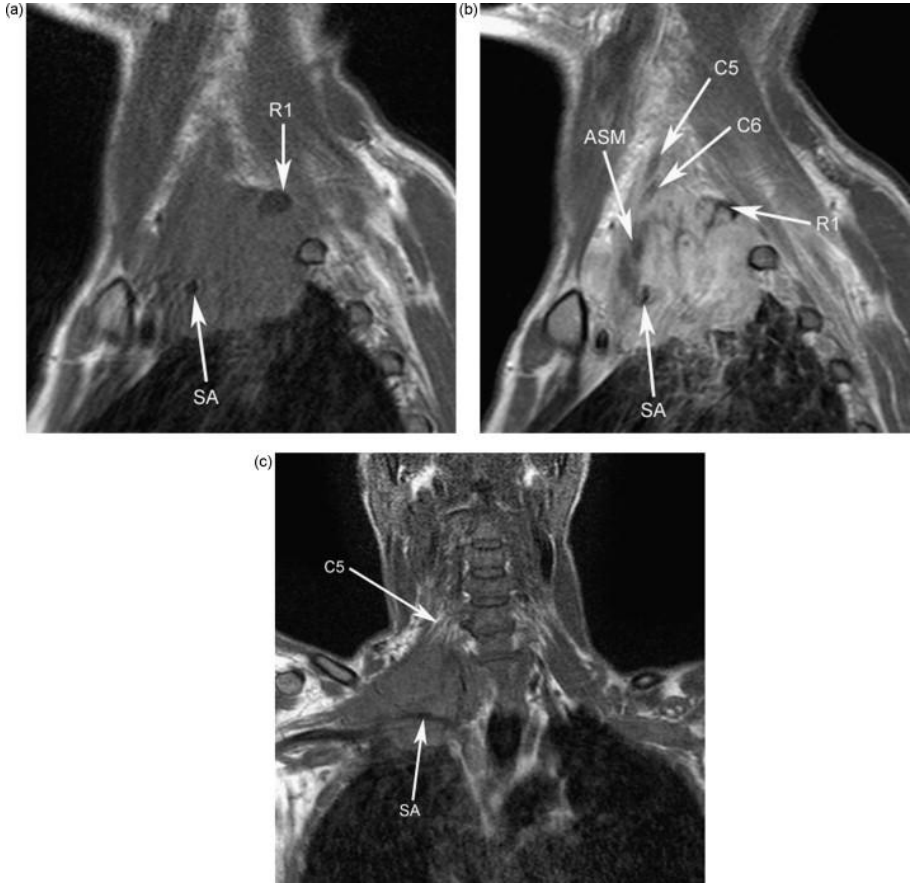


Figure 4: Graph shows detection and size of pulmonary nodules at MR imaging and CT.

1. Rajaram S, Swift AJ, Capener D, Telfer A, Davies C, Hill C, et al. Lung morphology assessment with balanced steady-state free precession MR imaging compared with CT. Radiology. 2012 May;263(2):569–77.

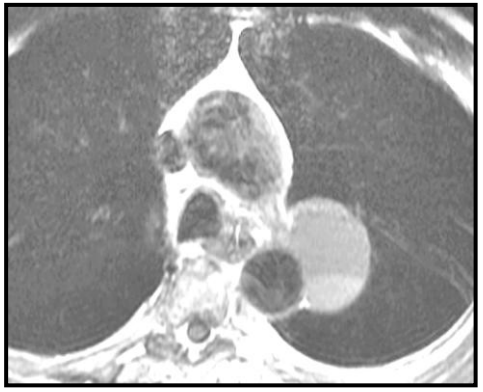
Néoplasie

- Anatomie des tumeurs de l'apex



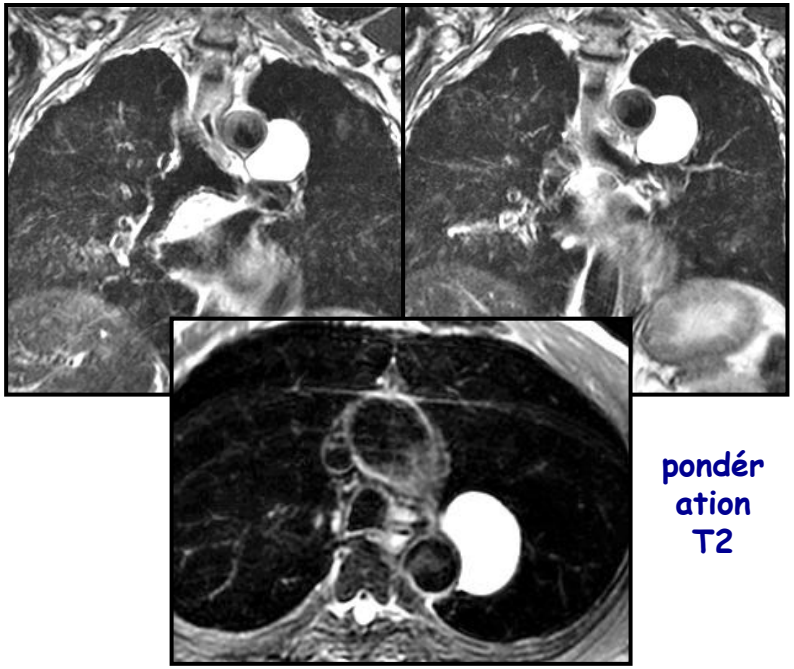
Néoplasie

- Caractérisation tissulaire

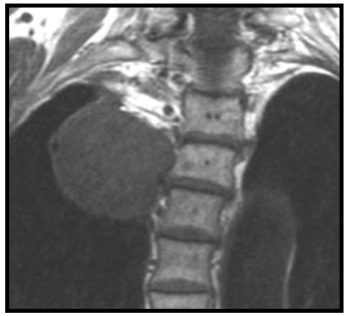


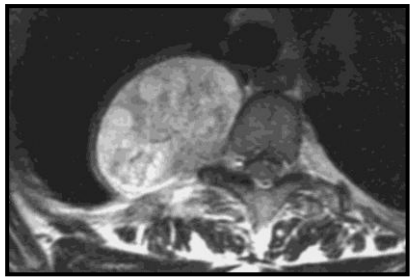
pondération T1

Kyste bronchogènique



pondération T2





Neurinome dorsal

Staging

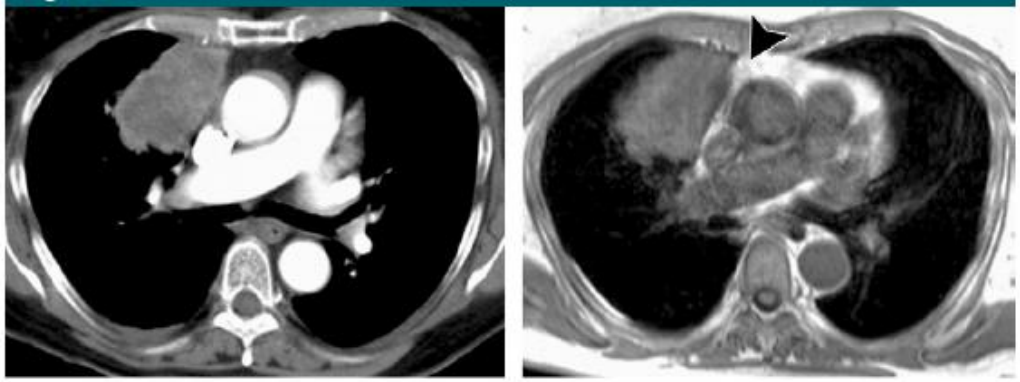
Table 2

Tumor Staging Results

Patient No.	TNM Stage at PET/CT	TNM Stage at MR/PET Imaging
1	T1bN0M0	T1bN0M0
2	T2–3N0M0	T2N0M0
3	T3N2M0	T3N2M0
4	T4N2M1b	T4N2M1b
5	T3N0–2M0	T3N0M0
6	T1bN0M0	T1aN0M0
7	T1aN1M0	T1aN1M0
8	T1bN0M0	T1bN0M0
9	T4N2M0	T4N2M0
10	T1aN0M0	T1aN0M0

Note.—Differences in TNM stage were found in patients 2, 5, and 6. TNM stages in patients 3 and 10 are for lesions classified as pneumonia after histologic work-up.

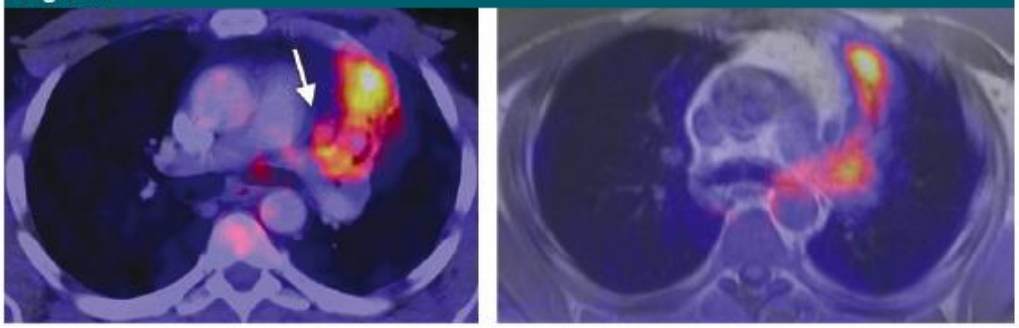
Figure 2



a. b.

Figure 2: **(a)** Axial contrast-enhanced CT scan obtained in the arterial phase in patient 2. **(b)** Axial T1-weighted VIBE MR image in which the prevailing paraaortal fat stripe (arrowhead) is clearly visible.

Figure 3



1. Schwenzer NF, Schraml C, Muller M, Brendle C, Sauter A, Spengler W, et al. Pulmonary Lesion Assessment: Comparison of Whole-Body Hybrid MR/PET and PET/CT Imaging--Pilot Study. Radiology. 2012 Jul 20;264(2):551–8.

Staging

N Stage Disease in Patients with Non–Small Cell Lung Cancer:

Efficacy of Quantitative and Qualitative Assessment with STIR Turbo Spin-Echo Imaging, Diffusion-weighted MR Imaging, and Fluorodeoxyglucose PET/CT[1]

Ohno et al. Radiology 2011

Figure 3

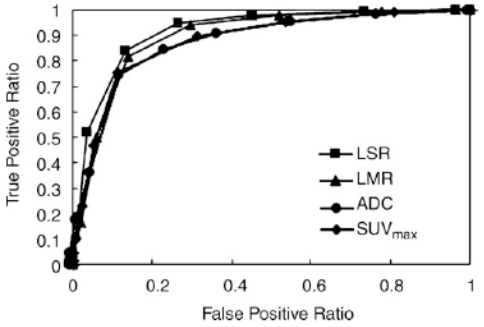


Figure 3: Receiver operating characteristic curve used for analysis of quantitative assessments with STIR turbo SE imaging, DW MR imaging, and integrated FDG PET/CT on a per-node basis. There were no significant differences between any of the quantitative methods. The threshold values were as follows: LSR, 0.6; LMR, 1.4; ADC, 2.5 × 10^{-3} sec/mm^2; and SUV_{max}, 2.0.

Figure 4

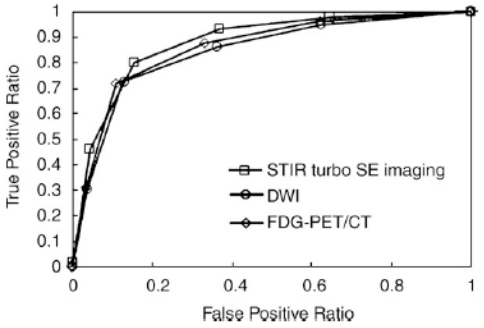
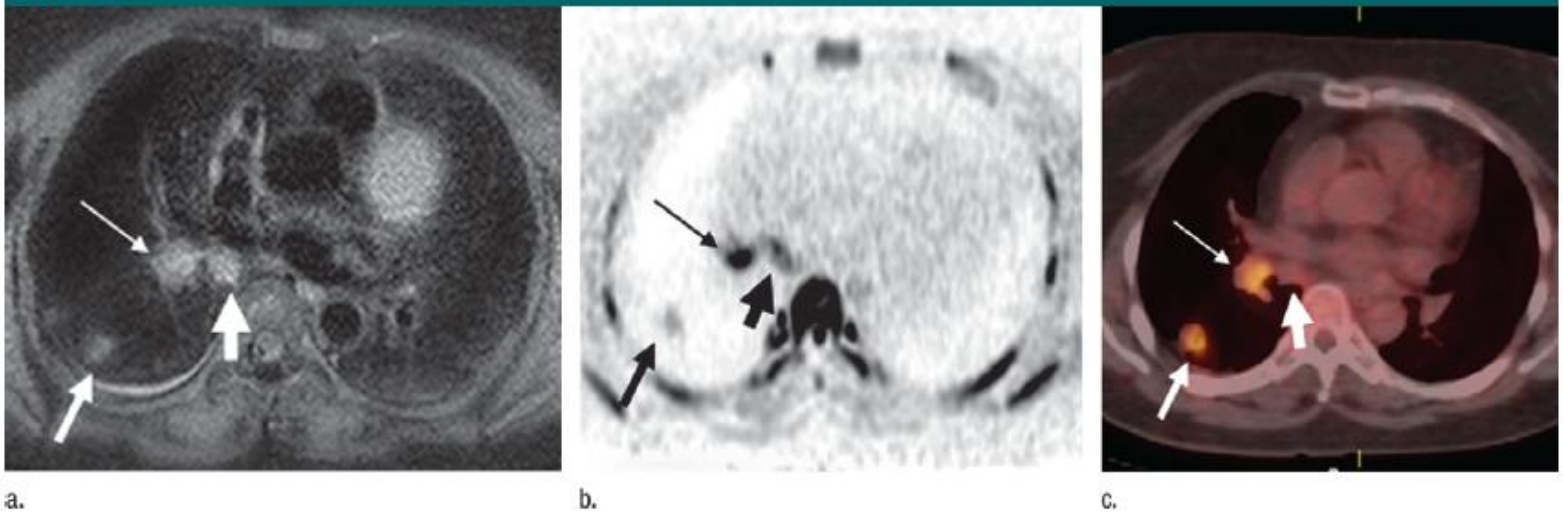
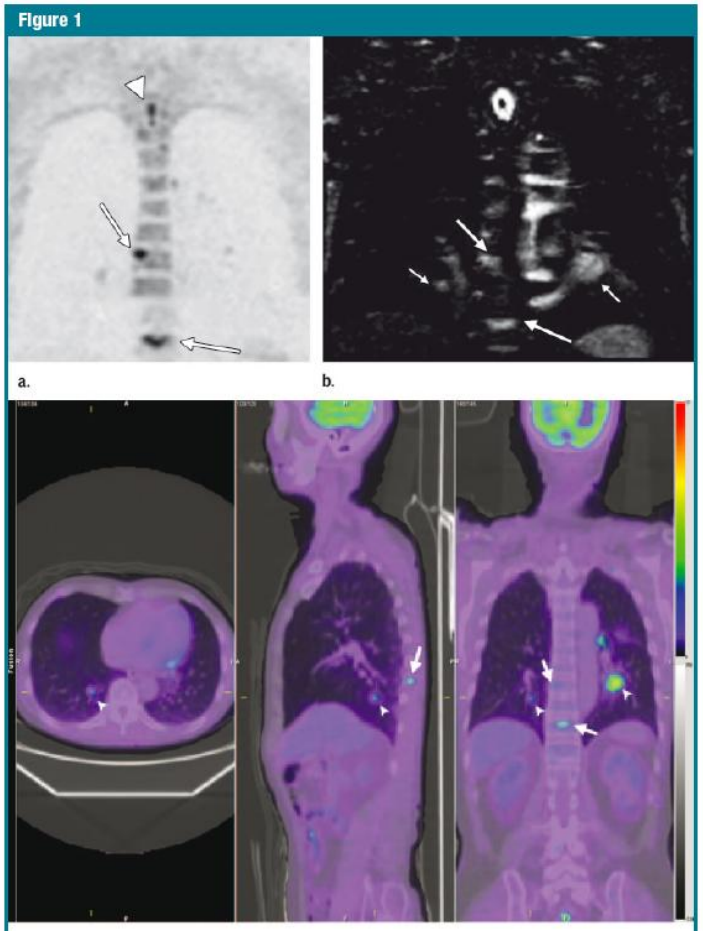


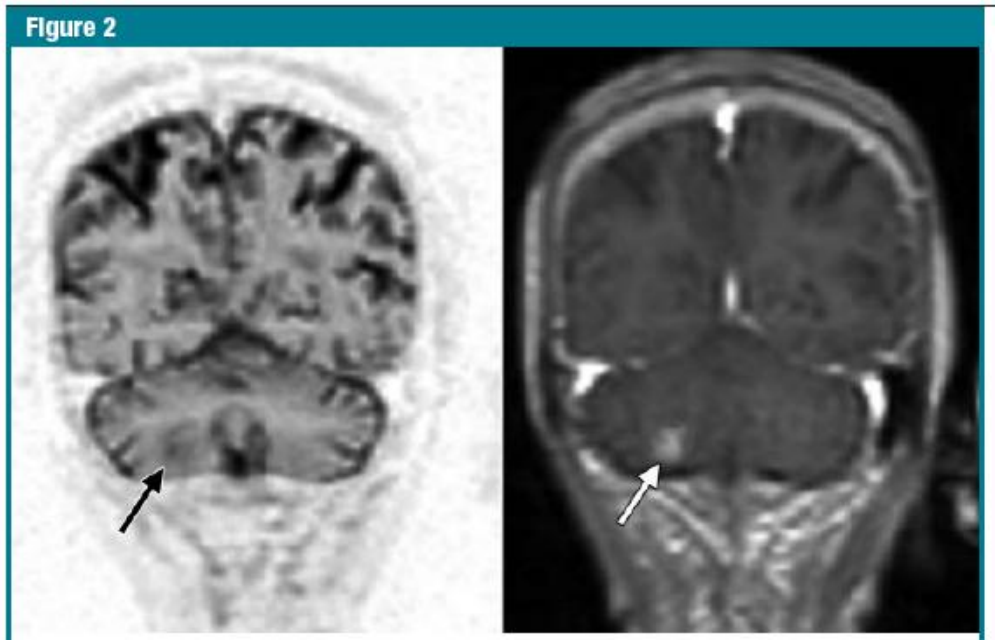
Figure 4: Receiver operating characteristic curve used for analysis of qualitative assessments with STIR turbo SE imaging, DW MR imaging, and integrated FDG PET/CT on a per-node basis. There were no significant differences between any of the qualitative methods. The threshold value for each method was 4.0.

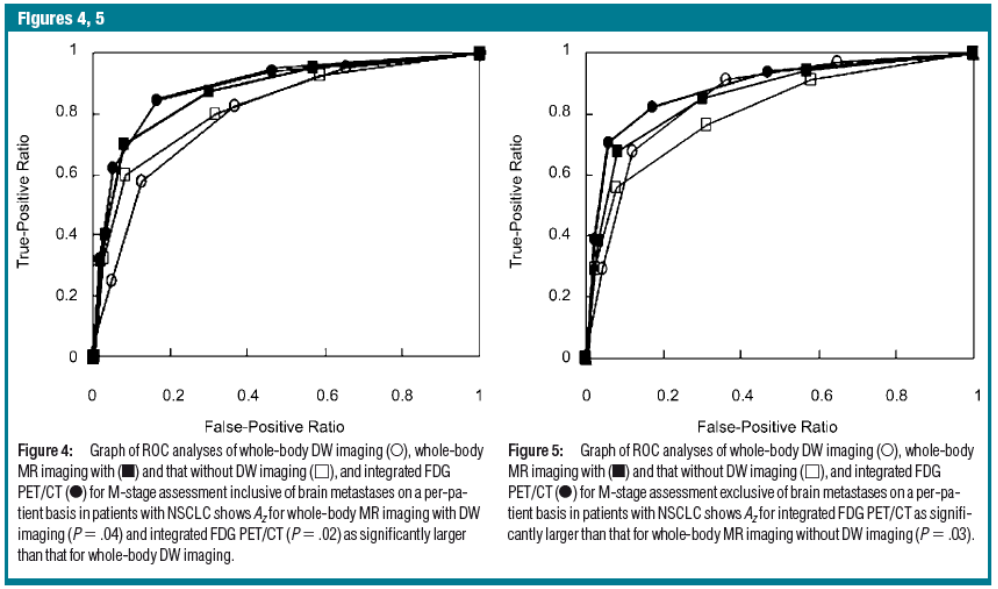
Figure 1



M Staging

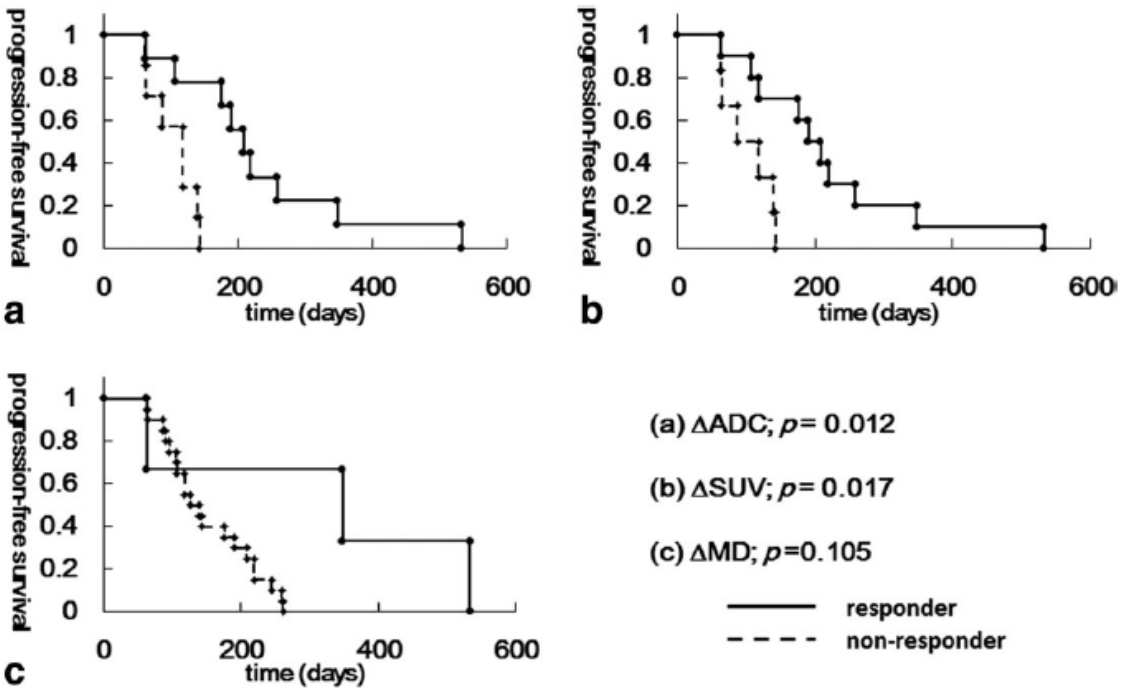






1. Ohno Y, Koyama H, Onishi Y, Takenaka D, Nogami M, Yoshikawa T, et al. Non-Small Cell Lung Cancer: Whole-Body MR Examination for M-Stage Assessment--Utility for Whole-Body Diffusion-weighted Imaging Compared with Integrated FDG PET/CT. Radiology. 2008 Jul 18;248(2):643–54.

Réponse au traitement



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Points clés

- Limites techniques de l'IRM pour l'exploration du parenchyme pulmonaire
- Analyse fonctionnelle non irradiante ?

- Place en oncologie à définir selon évolutions