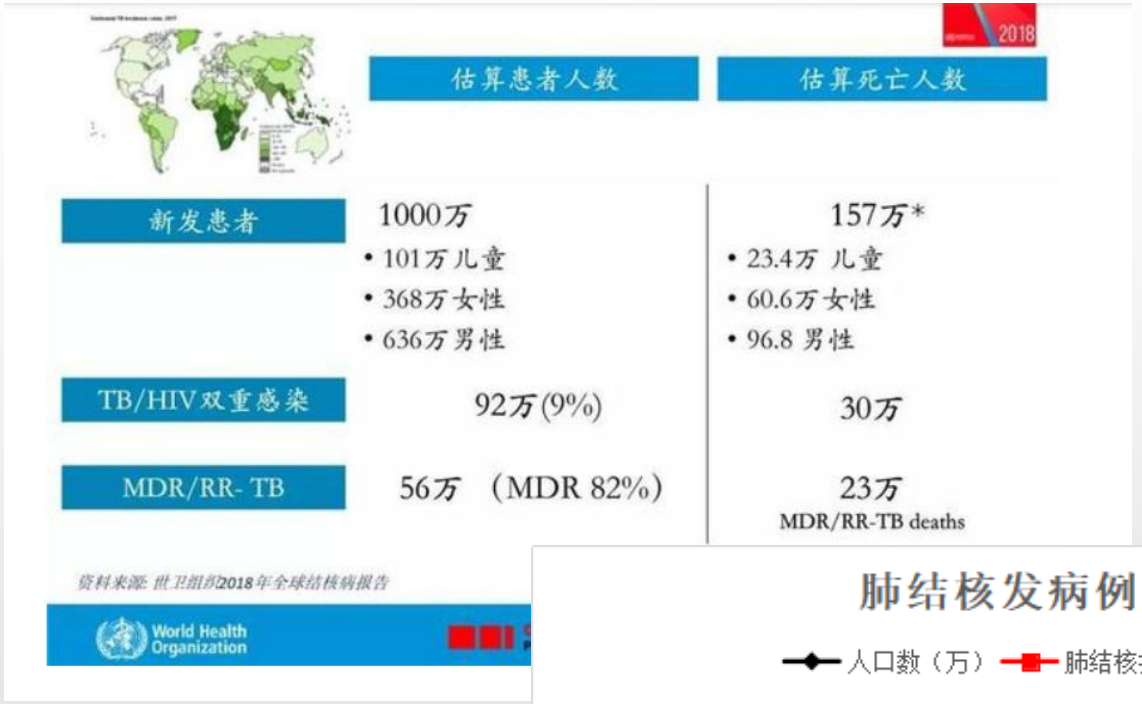
肺结核的MRI形态和功能成像诊断进展

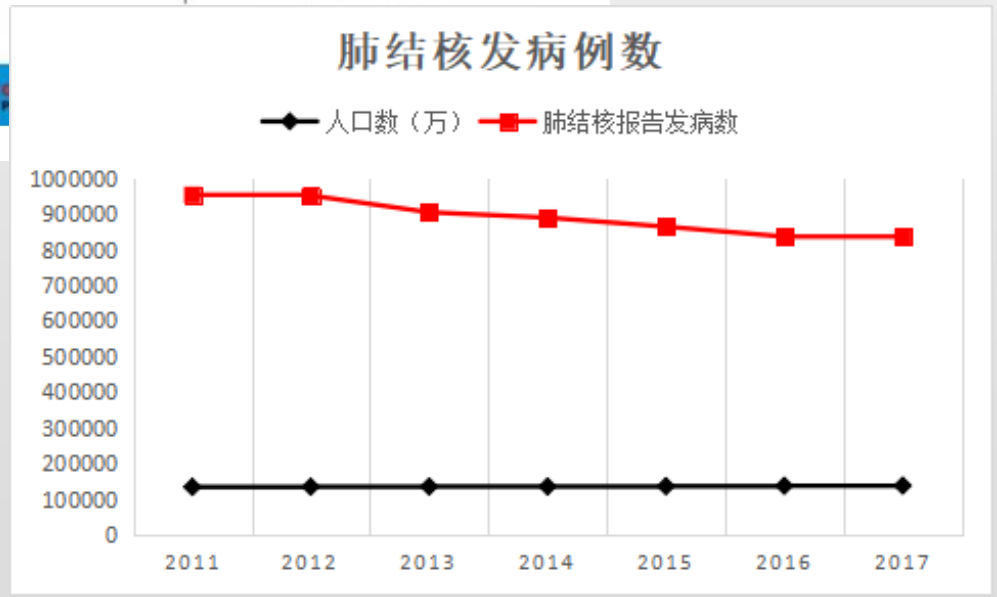
施裕新

上海市（复旦大学附属）公共卫生临床中心

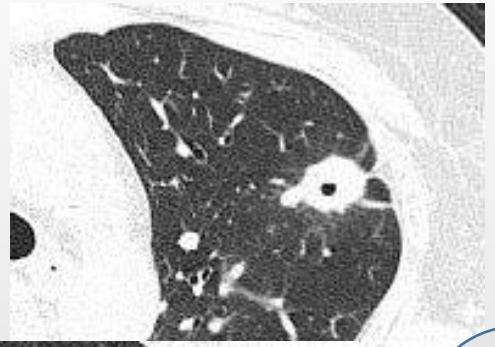
肺结核特点：

- 发病率高
- 死亡率高
- 耐药率高
- 年递减率低
- 多器官、多部位、多组织
- 影像表现多样性





影像诊断方法：

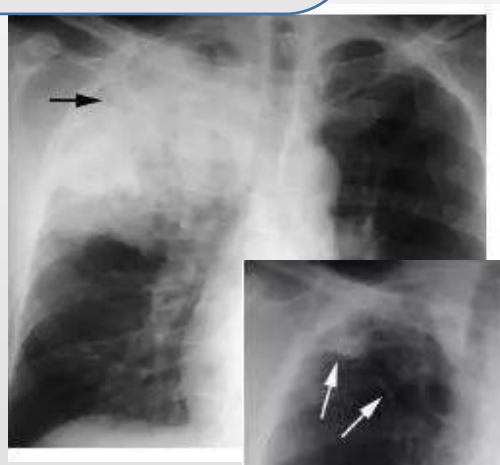


CT:

- 空间分辨率高
- 发现隐匿病灶
- 显示病灶细节
- 累积放射损害
- 病变成分显示能力有限

X线:

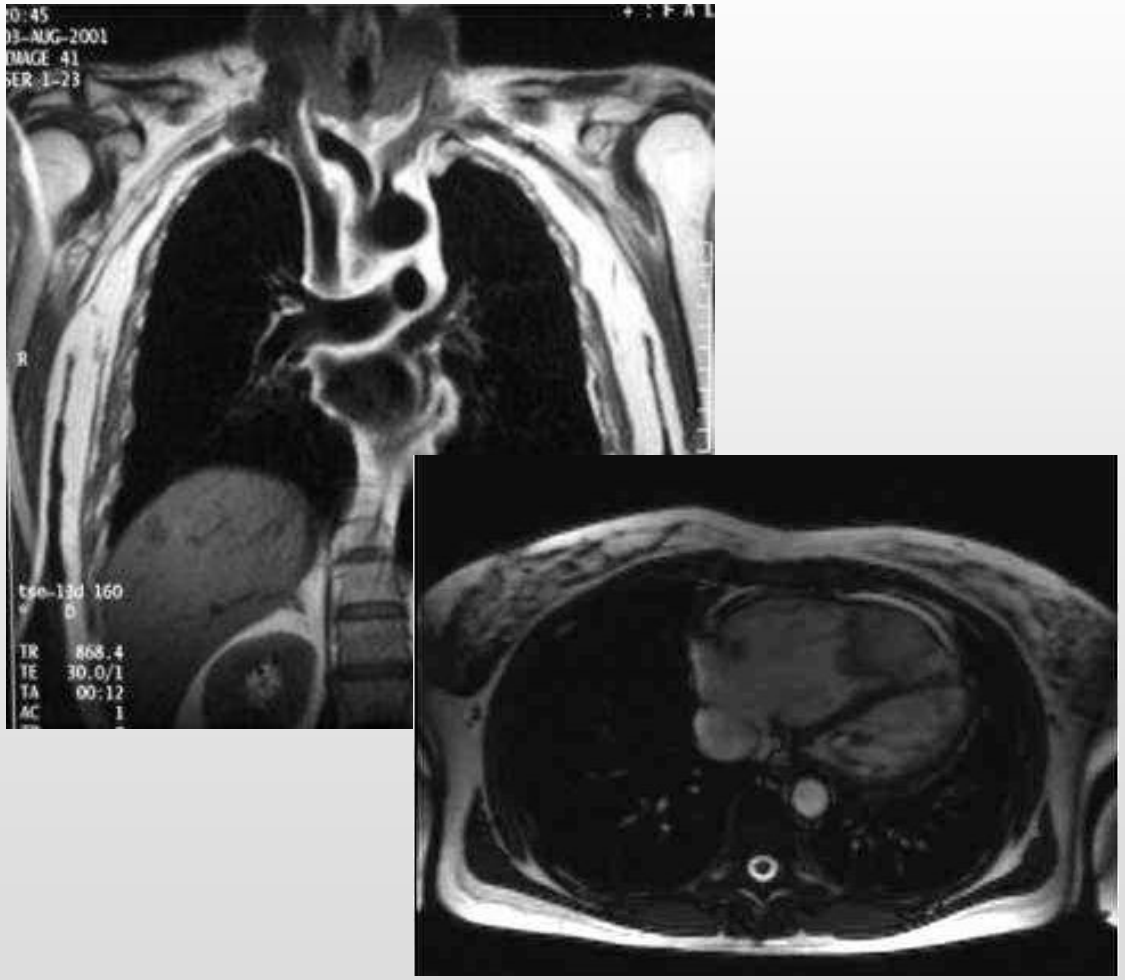
- 筛查、简便、便宜
- 漏诊率高
- 不能显示细节



影像诊断方法：

MRI:

- 软组织分辨率高
- 多断面、多参数成像
- 显示病变成分
- 鉴别良恶性
- 无放射损害（长期随访）
- 空间分辨率低



影像诊断方法：

无放射损害

- 儿童和孕妇
- 定期和长期随访

多序列、多参数成像

- 形态学特征
- 显示病变成分

功能成像

- 评估早期治疗改变
- 鉴别诊断

肺病变的MRI检出：

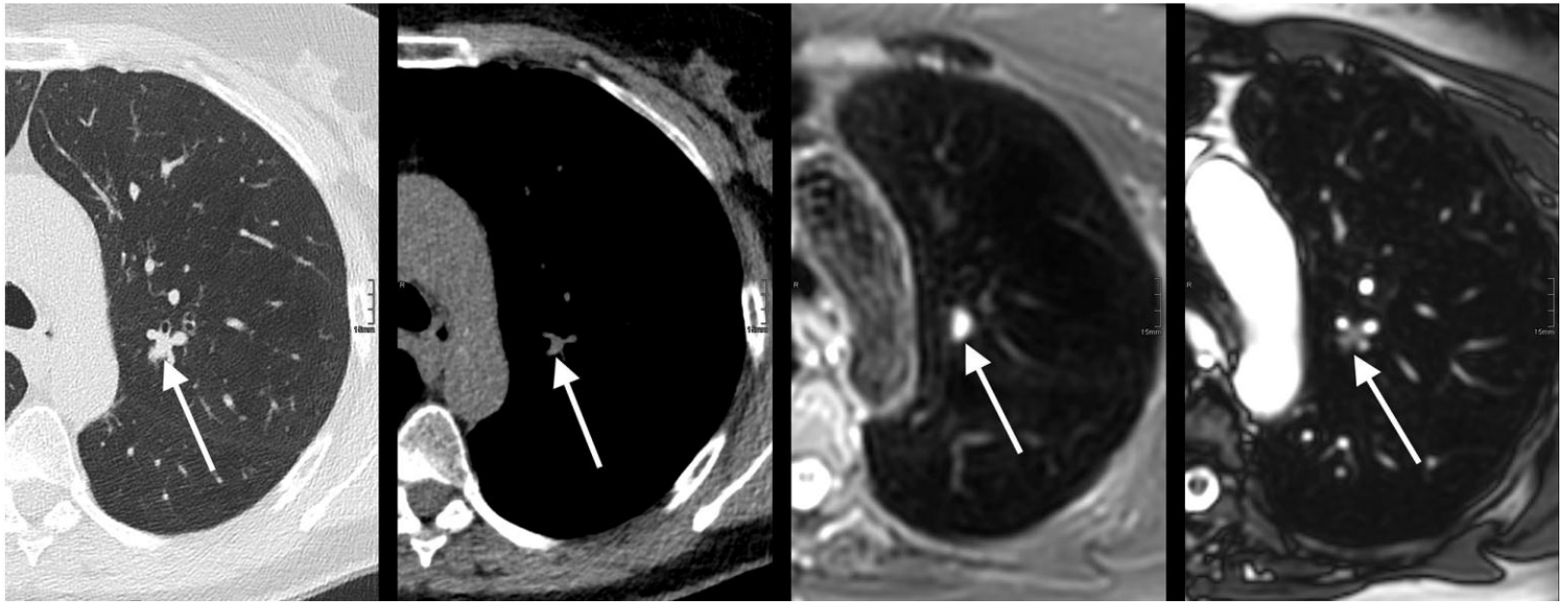
常规序列：

- 总体检出率与敏感度45.5%-96%（1.5T，3.0T）
- TSE>GRE
- STIR-90%（>3mm）
- HASTE-97.6%（≥5mm，1.5T）
- 3D VIBE-93.1%（≥5mm，CAIPIRINHA，3.0T）

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	AUC
Solid nodules					
4–5 mm	69.3	96.4	91.0	85.8	0.829
6–7 mm	95.2	99.6	95.2	99.6	0.974
8–14 mm	100	99.6	92.3	100	0.998
≥ 15 mm	100	100	100	100	1.000
Subsolid nodules					
< 20 mm	72.7	99.2	80.0	98.8	0.860
≥ 20 mm	–	–	–	–	

- Koyama H, et al. Quantitative and qualitative assessment of non-contrast-enhanced pulmonary MR imaging for management of pulmonary nodules in 161 subjects. Eur Radiol. 2008;18:2120–2131.
- Schroeder, T., et al., Detection of Pulmonary Nodules Using a 2D HASTE MR Sequence: Comparison with MDCT. American Journal of Roentgenology, 2005. 185(4): p. 979-984.
- Dewes, P., et al., Comparative evaluation of non-contrast CAIPIRINHA-VIBE 3T-MRI and multidetector CT for detection of pulmonary nodules: In vivo evaluation of diagnostic accuracy and image quality. European Journal of Radiology, 2016. 85(1): p. 193-198.
- Meier-Schroers, M., et al., Lung cancer screening with MRI: results of the first screening round. Journal of Cancer Research and Clinical Oncology, 2018. 144(1): p. 117-125.

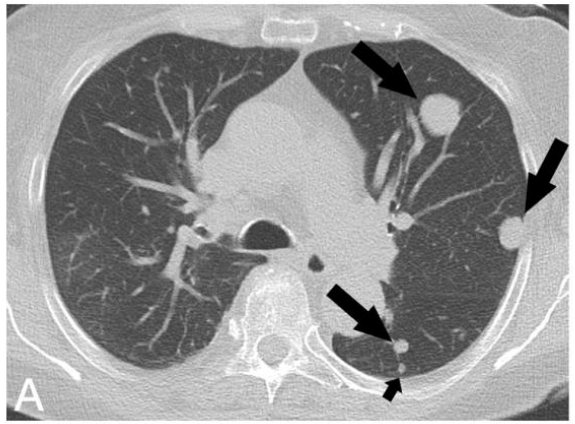
肺病变的MRI检出：

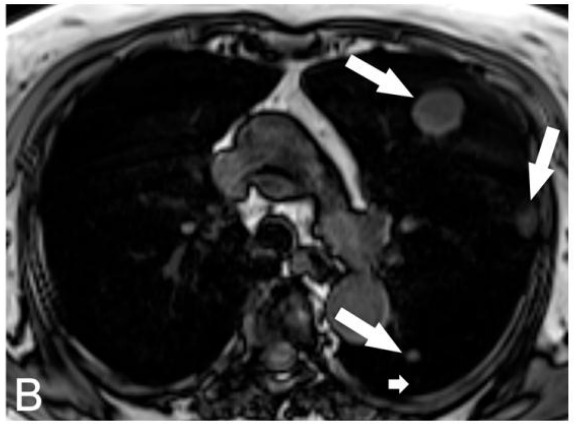


Solid 8-mm nodule between pulmonary vessels in the left upper lobe (from left to right: CT lung window, CT soft-tissue window, MRI T2 STIR MultiVane XD, and MRI-balanced steady-state-free precession)

- Meier-Schroers, M., et al., Lung cancer screening with MRI: results of the first screening round. Journal of Cancer Research and Clinical Oncology, 2018. 144(1): p. 117-125.

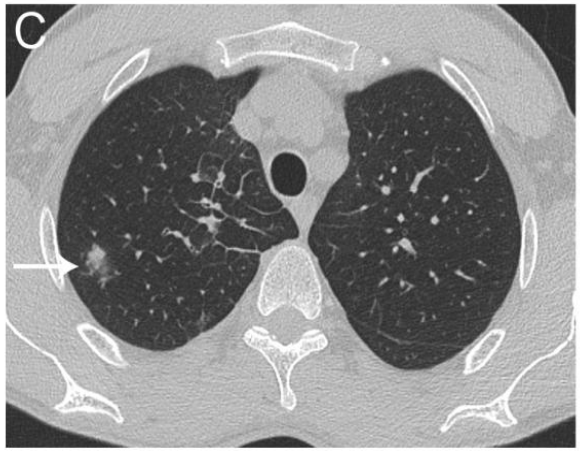
肺病变的MRI检出：

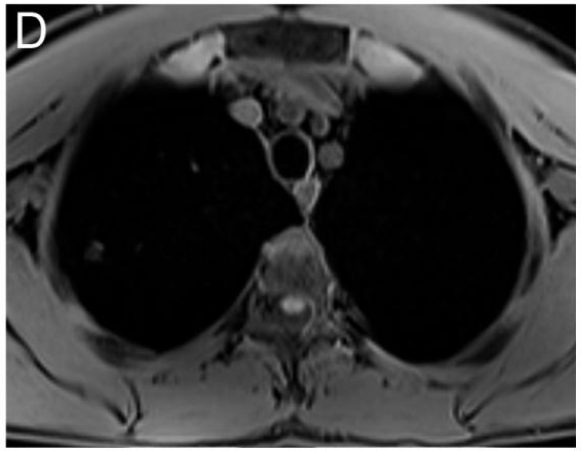




83岁，男，肝细胞癌肺转移，左上肺结节直径分别为17mm、10mm，左下肺结节直径分别为5mm、2mm，MRI未显示2mm结节，CT (A) ，CAIPIRINHA-VIBE 3T-MRI (B)

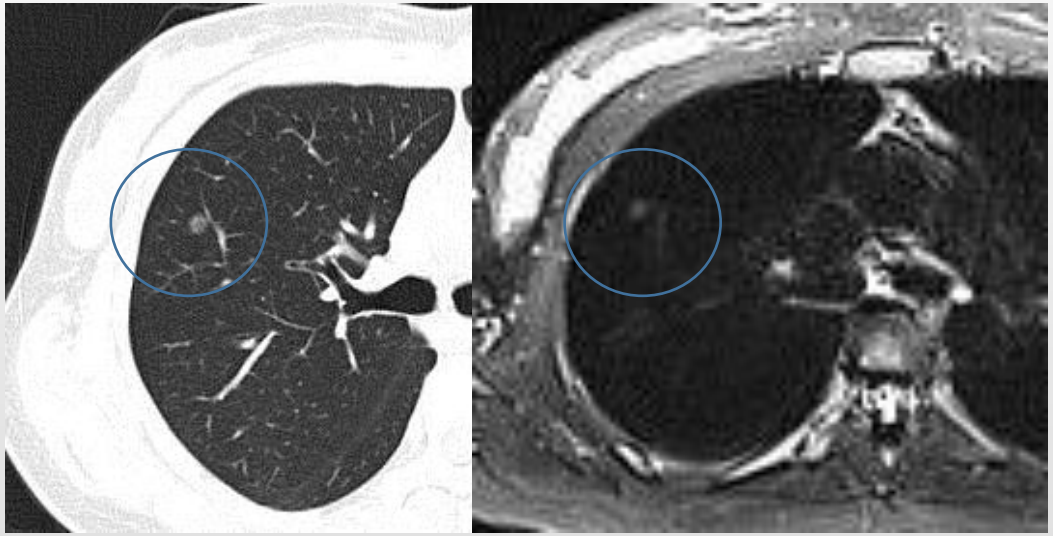
右中肺混合磨玻璃结节，CT（C），MRI（D）



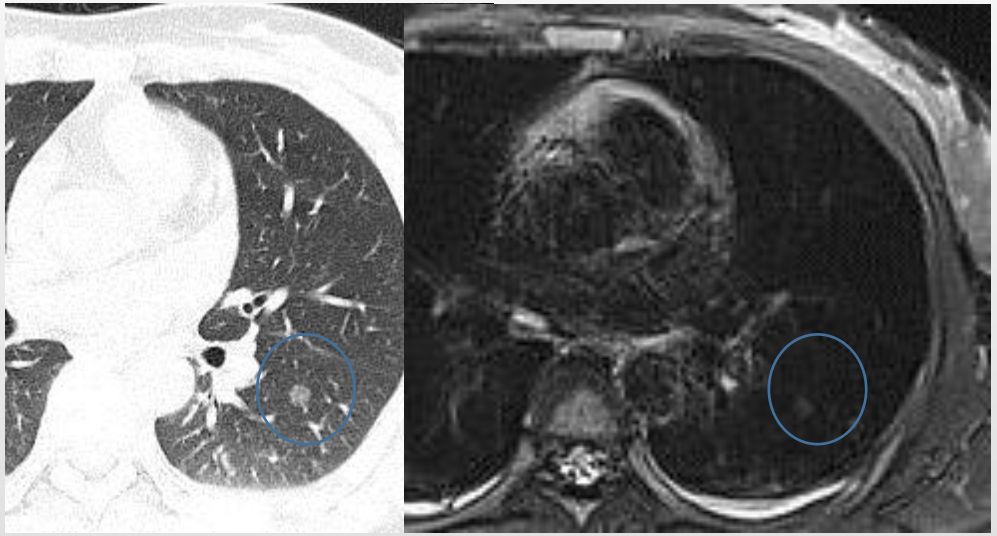


- Dewes, P., et al., Comparative evaluation of non-contrast CAIPIRINHA-VIBE 3T-MRI and multidetector CT for detection of pulmonary nodules: In vivo evaluation of diagnostic accuracy and image quality. European Journal of Radiology, 2016. 85(1): p. 193-198.

肺病变的MRI检出：



0.4mm纯磨玻璃结节



0.5mm纯磨玻璃结节

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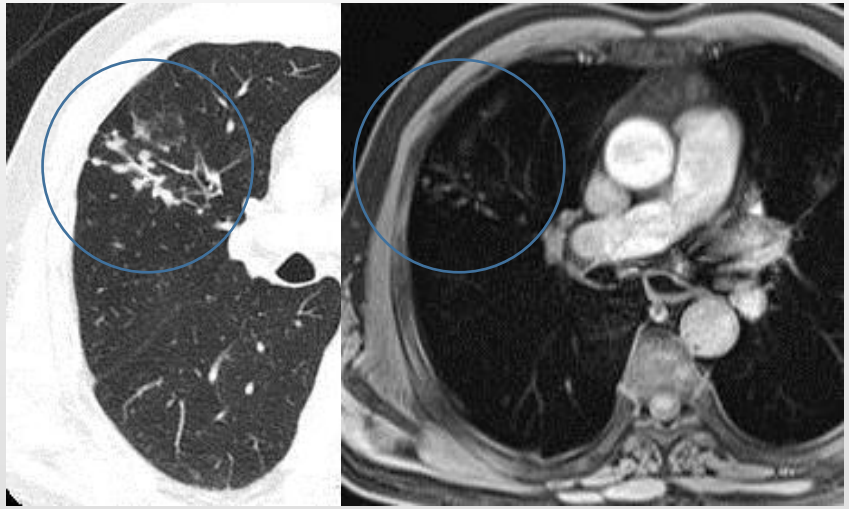
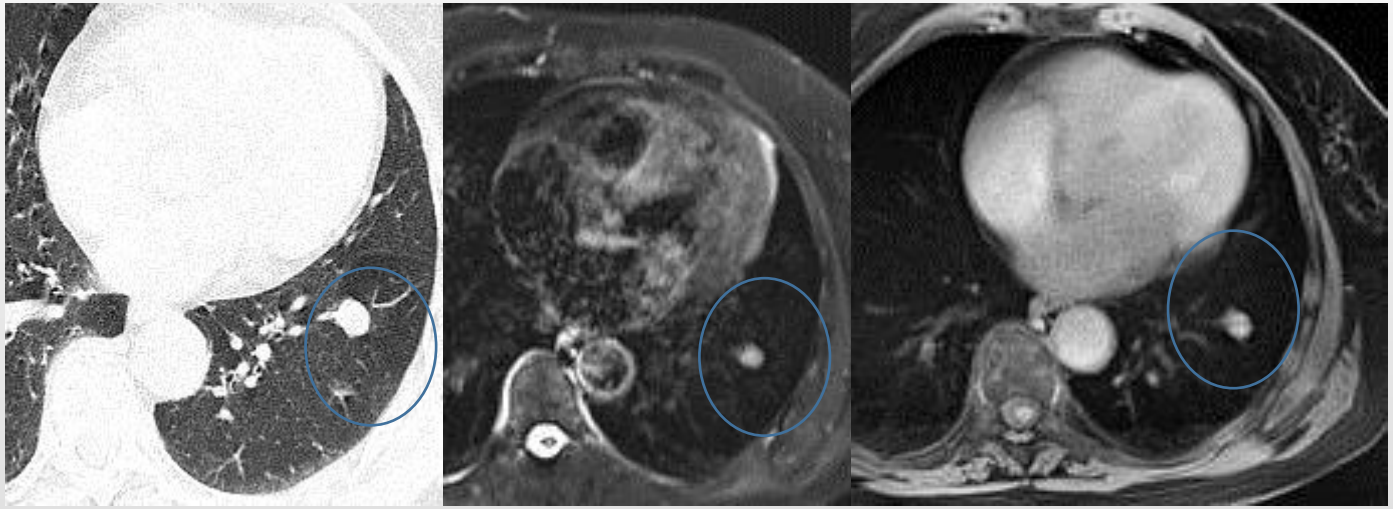
肺病变的MRI检出：





上海市（复旦大学附属）公共卫生临床中心病例

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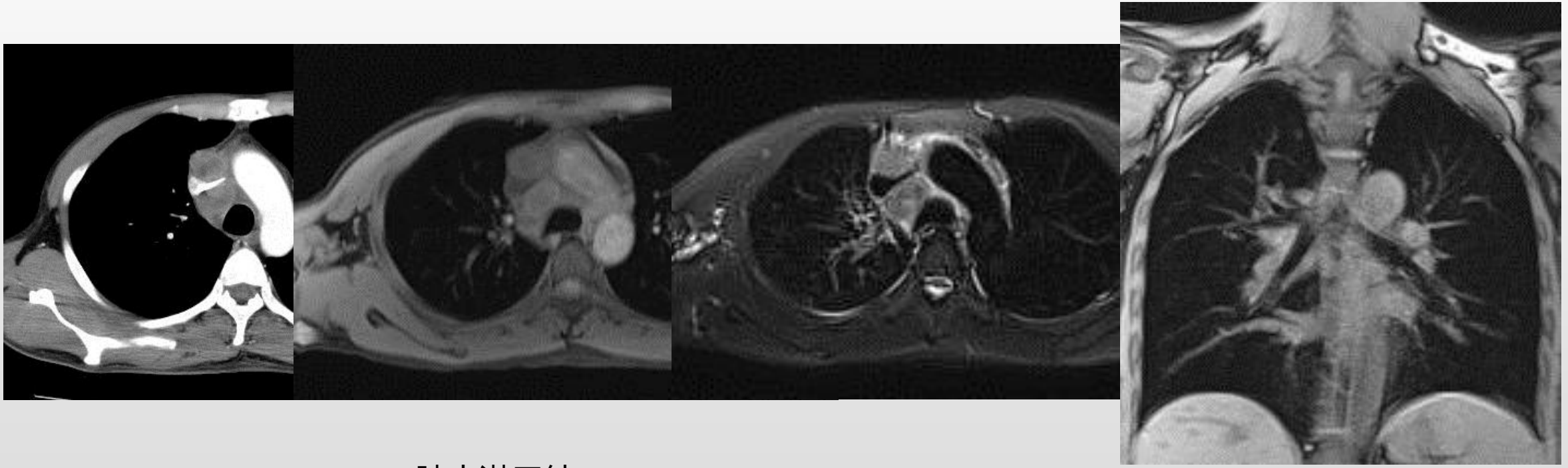
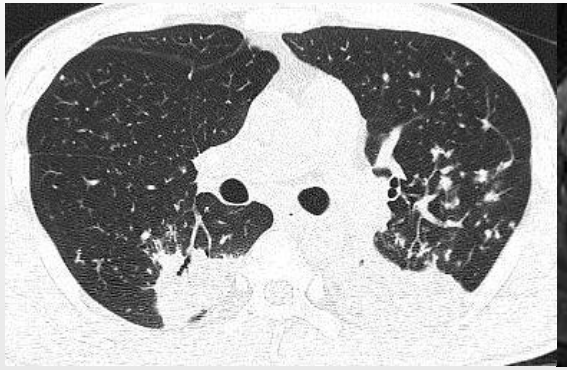
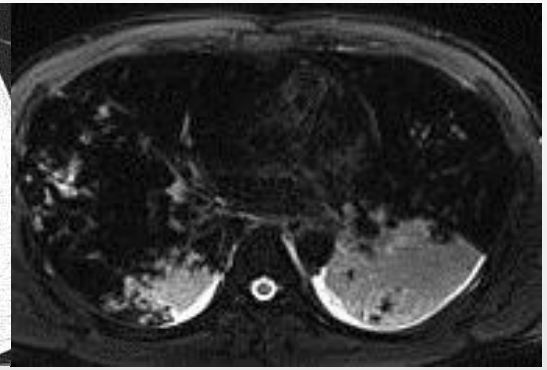
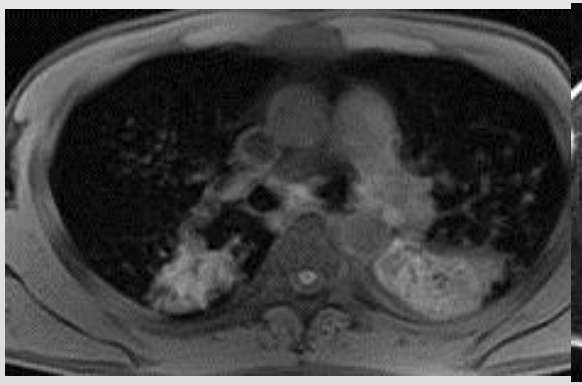


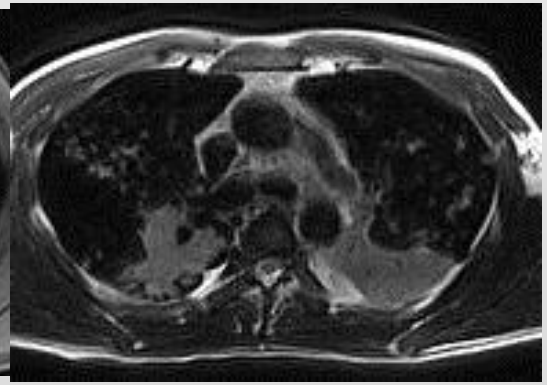
肿大淋巴结

肺病变的MRI检出：



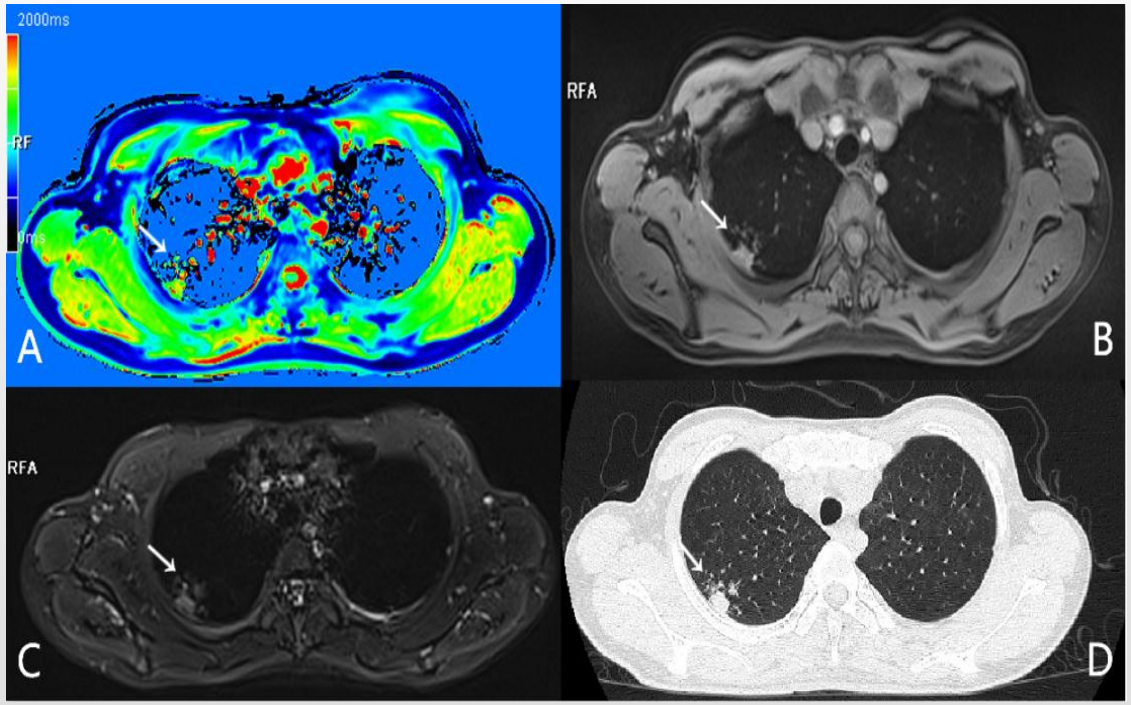


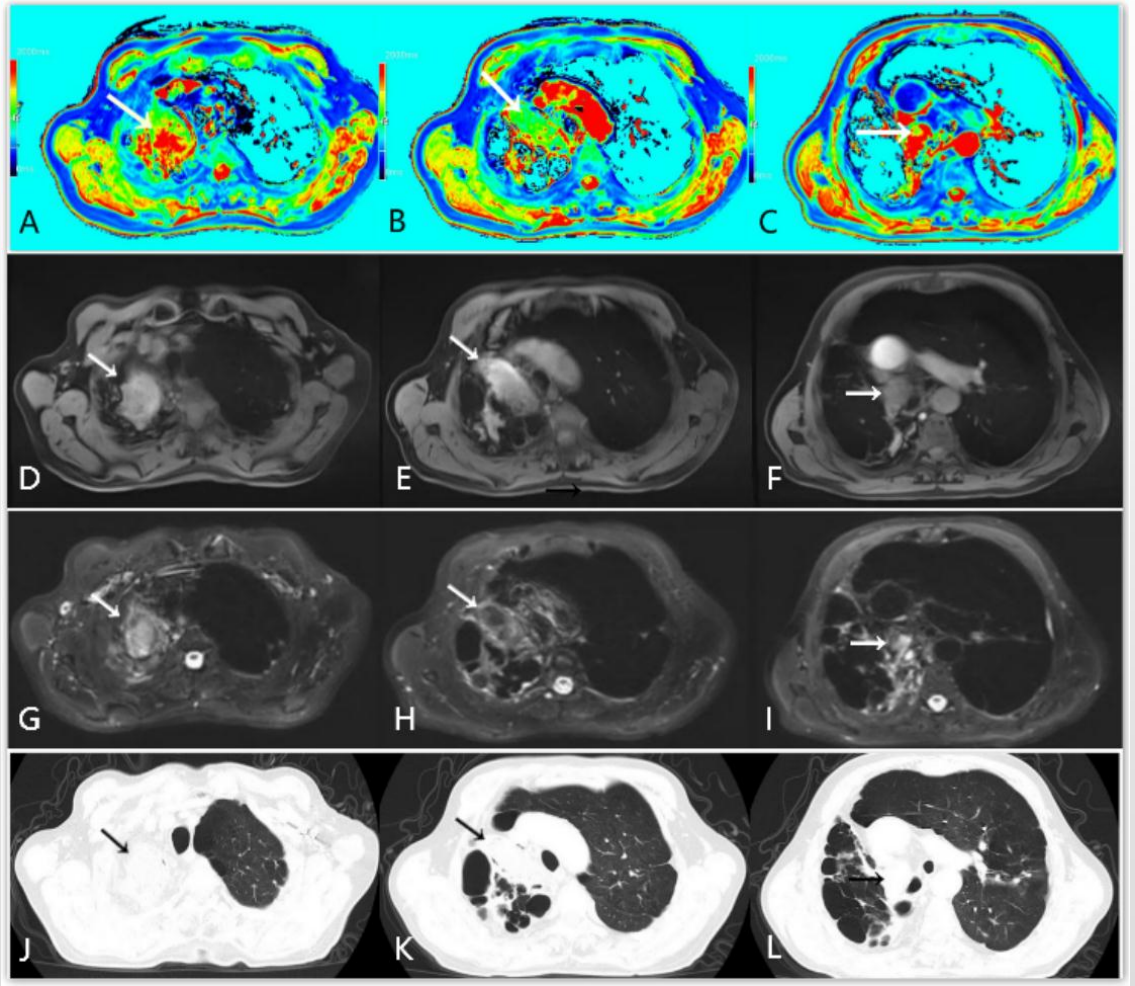




显示病变分布及范围

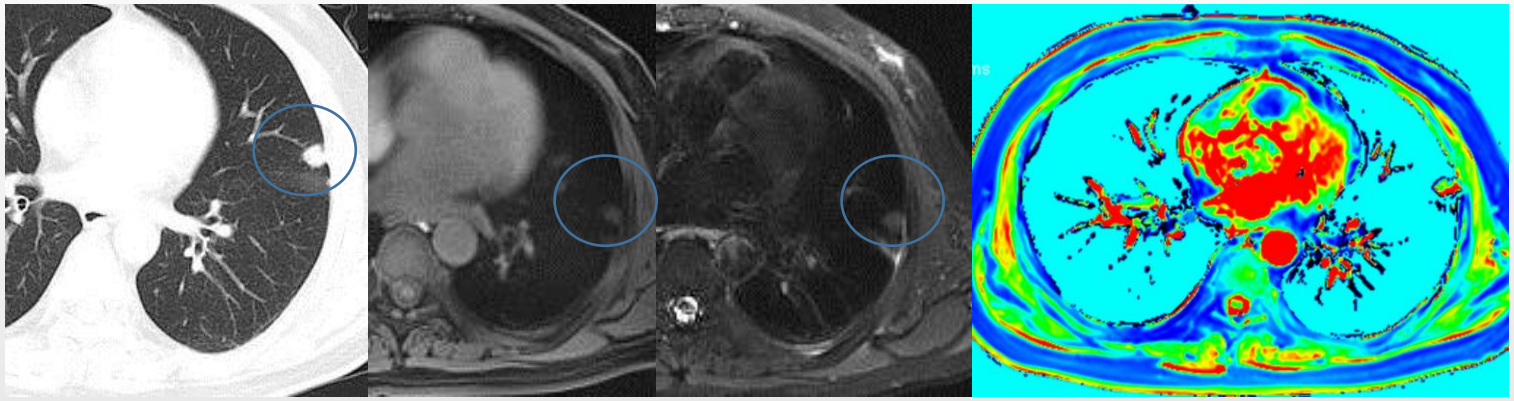
肺病变的MRI检出：

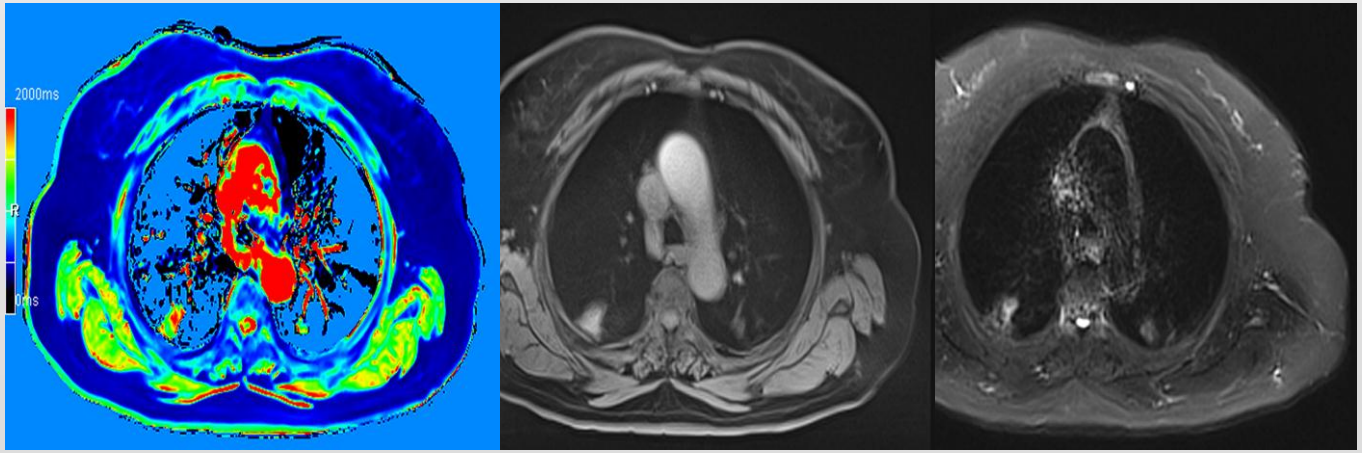




上海市（复旦大学附属）公共卫生临床中心病例

肺病变的MRI检出：



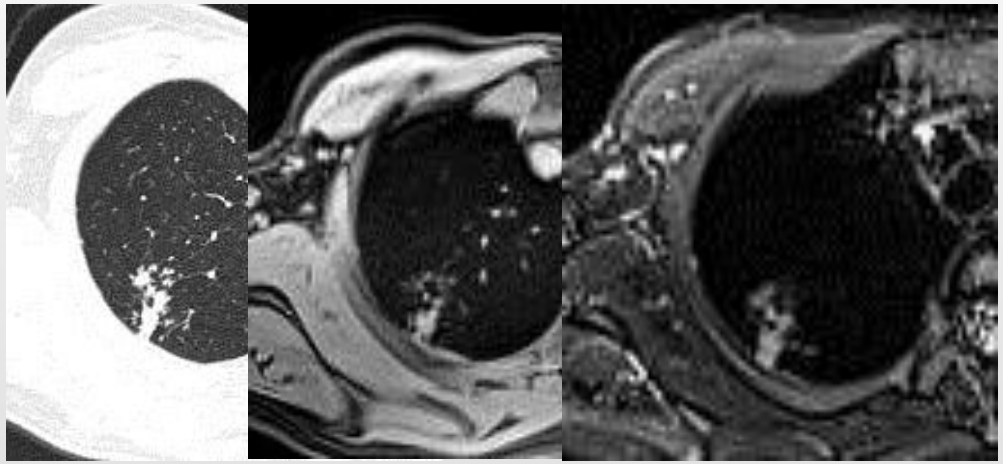


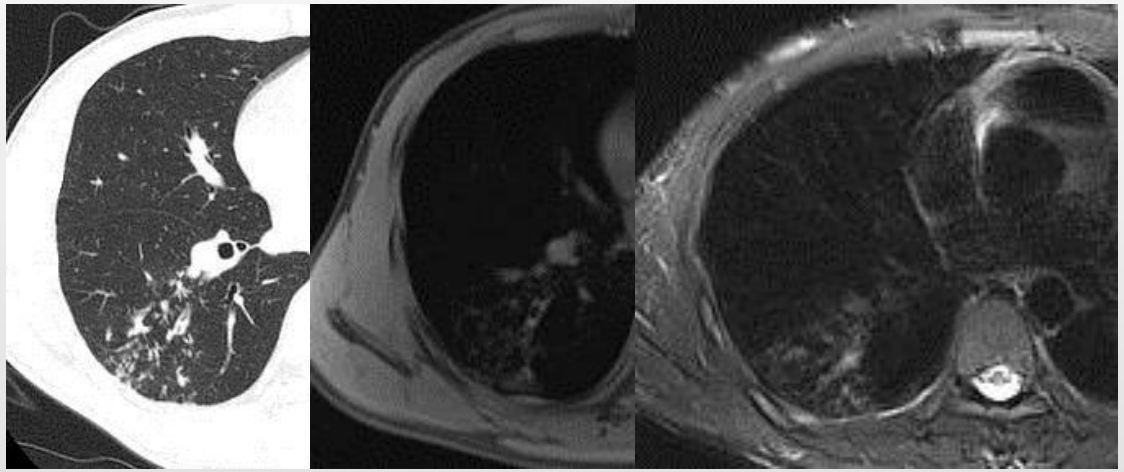
上海市（复旦大学附属）公共卫生临床中心病例

肺结核基本病变：

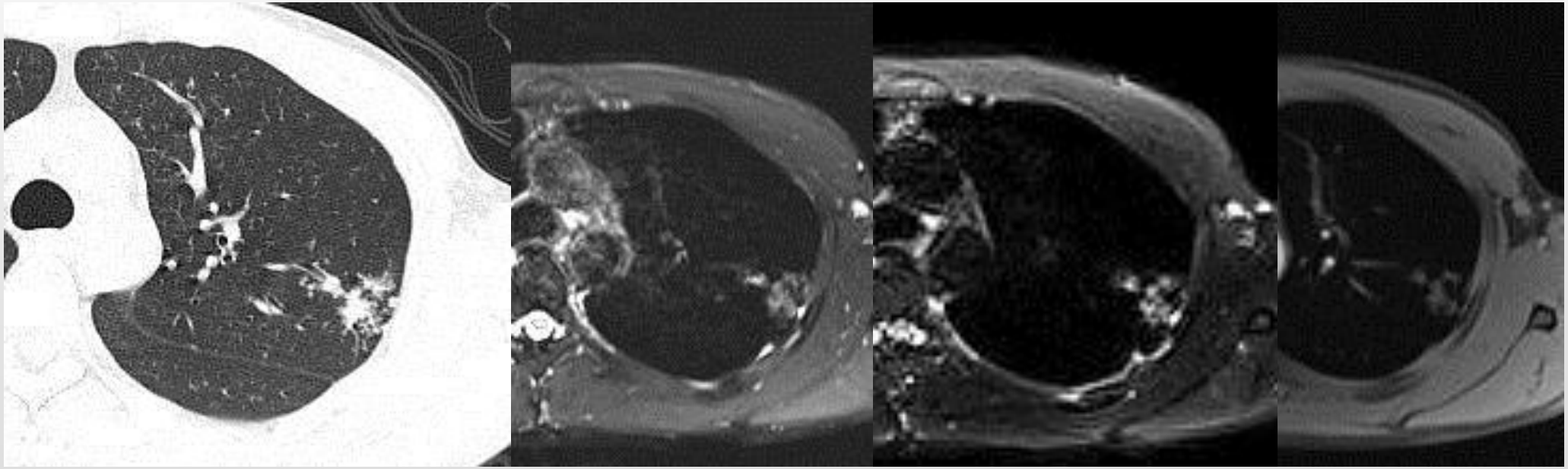
- 渗出性病变
- 增殖性病变
- 干酪性病变
- 空洞
- 纤维化和钙化

渗出性病变：

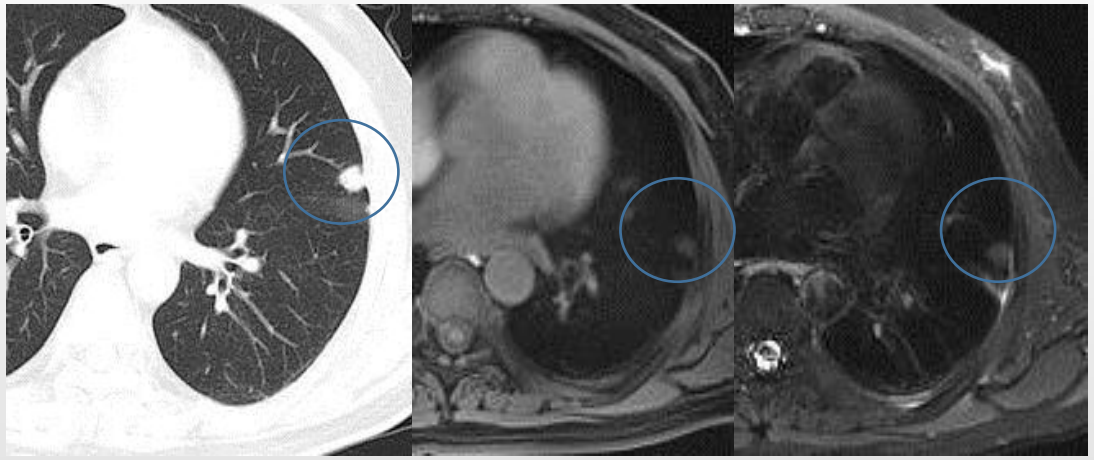


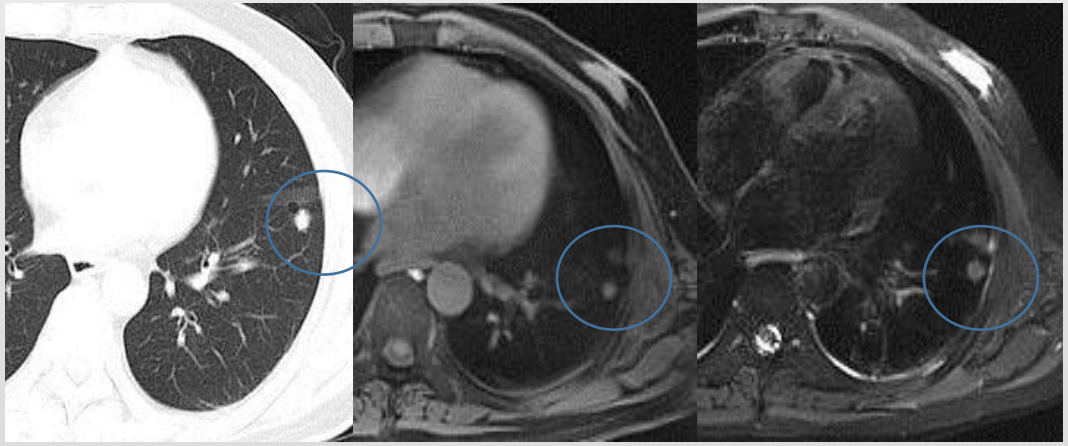


渗出性病变：



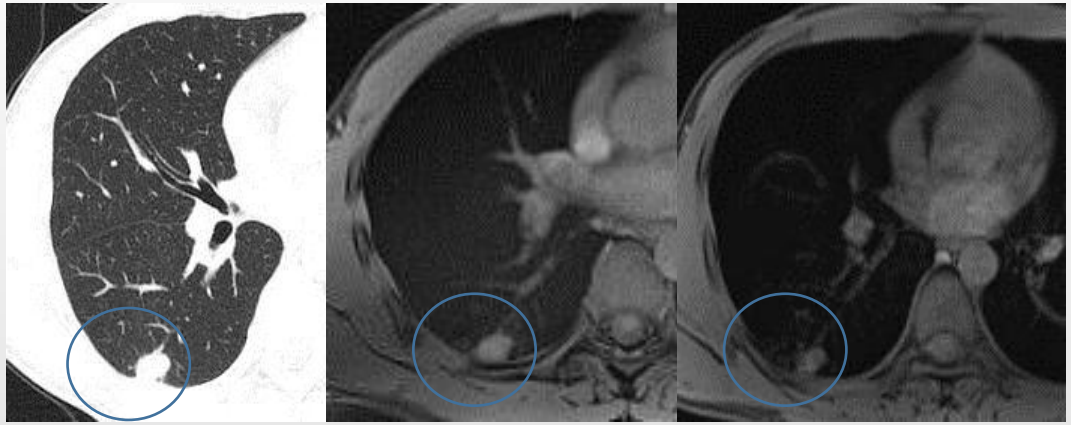
增殖性病变：

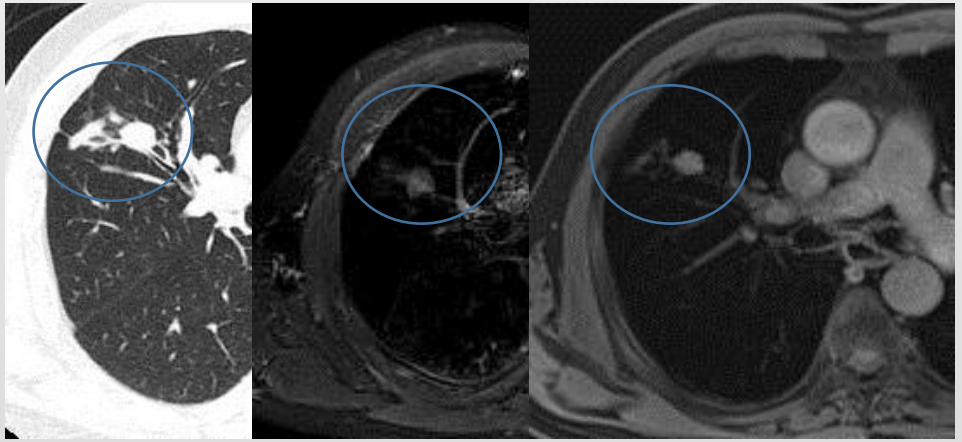




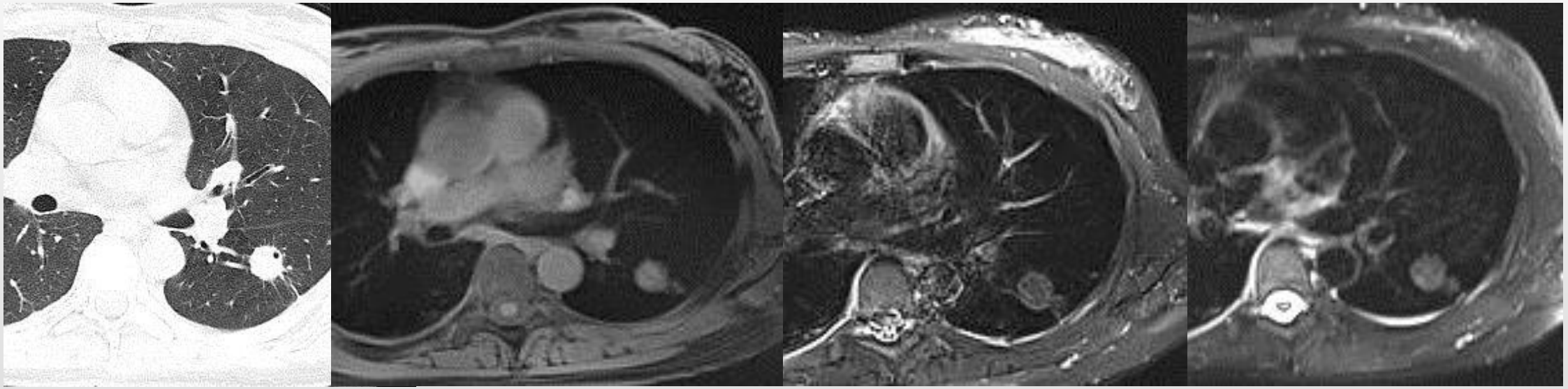
上海市（复旦大学附属）公共卫生临床中心病例

增殖性病变：

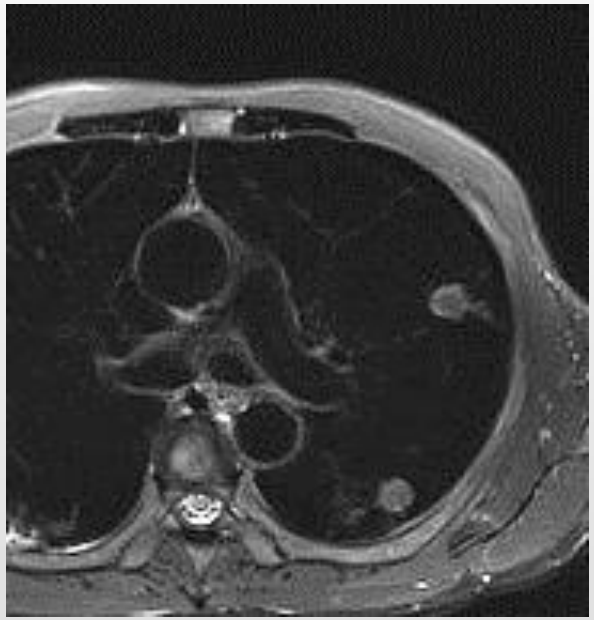




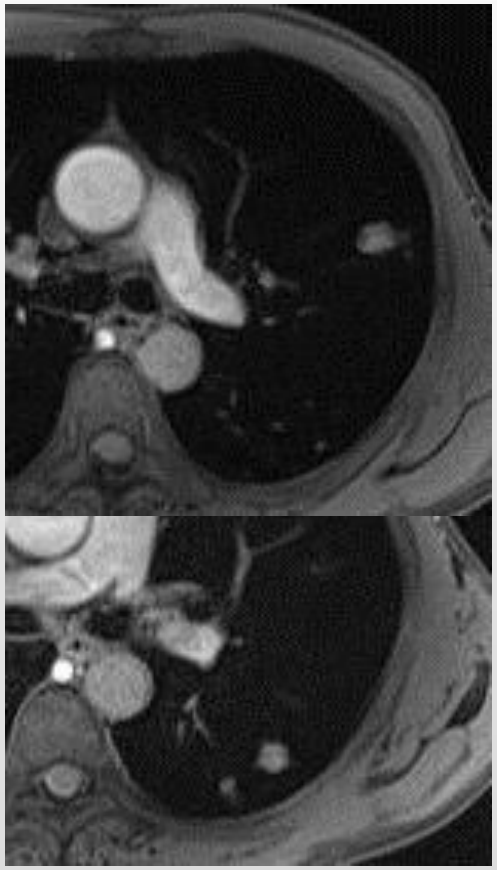
干酪性病变：



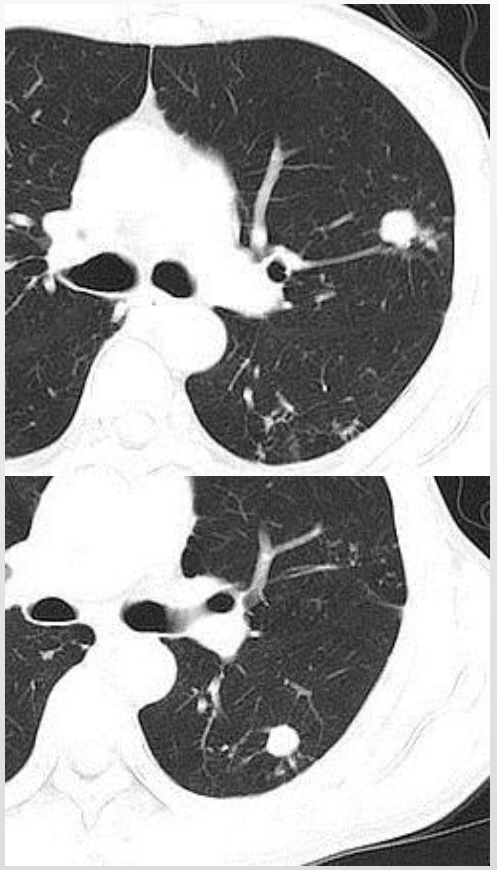
干酪性病变：



T2WI

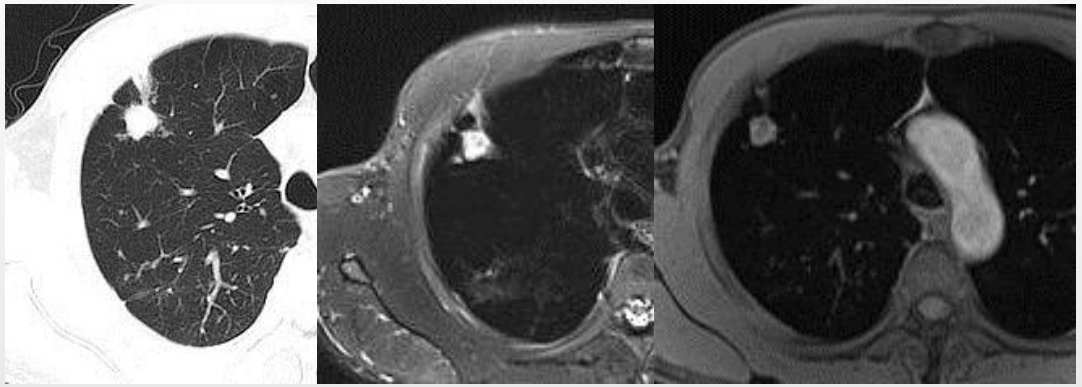


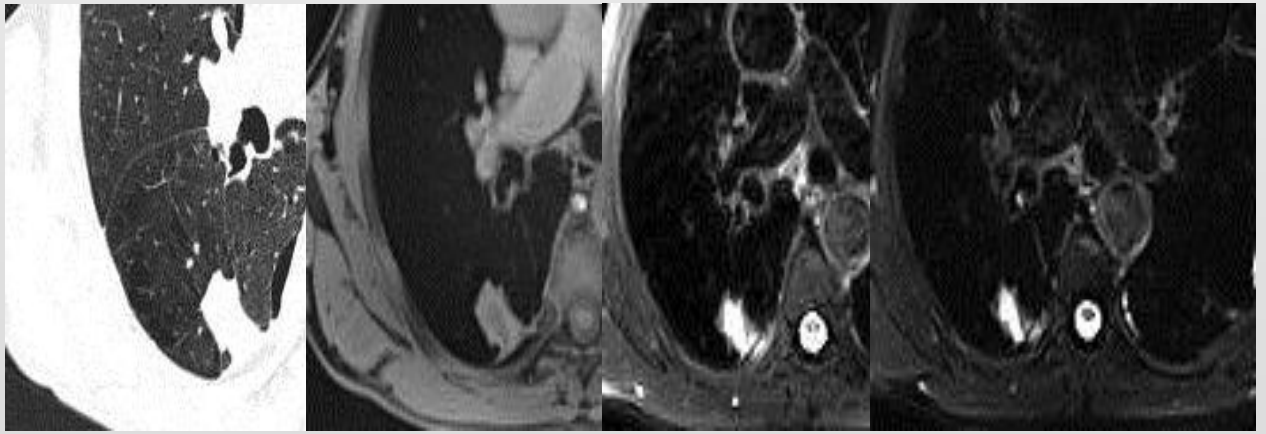
T1WI



CT

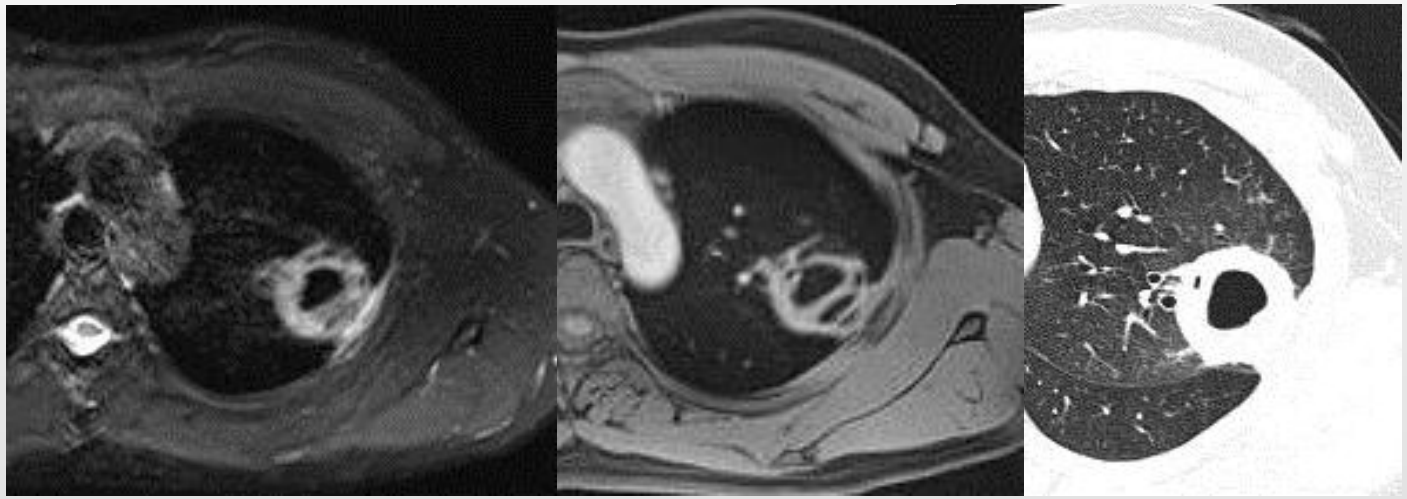
液化坏死病变：

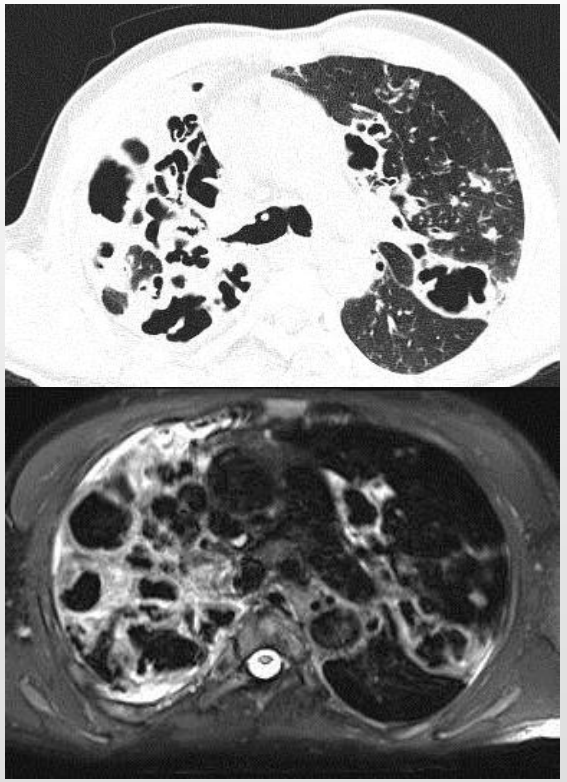




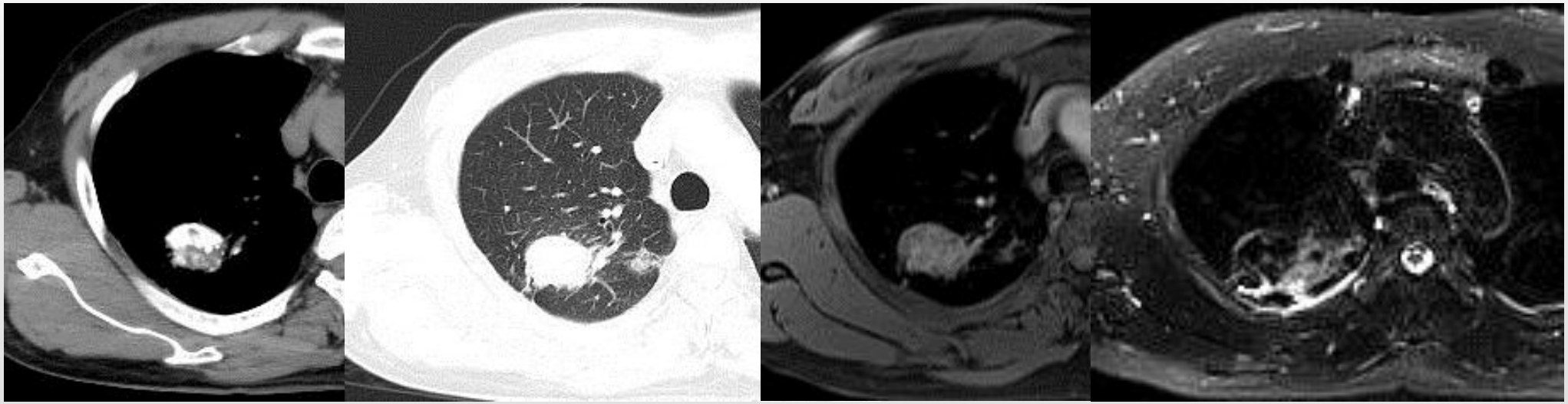
上海市（复旦大学附属）公共卫生临床中心病例

空洞病变：





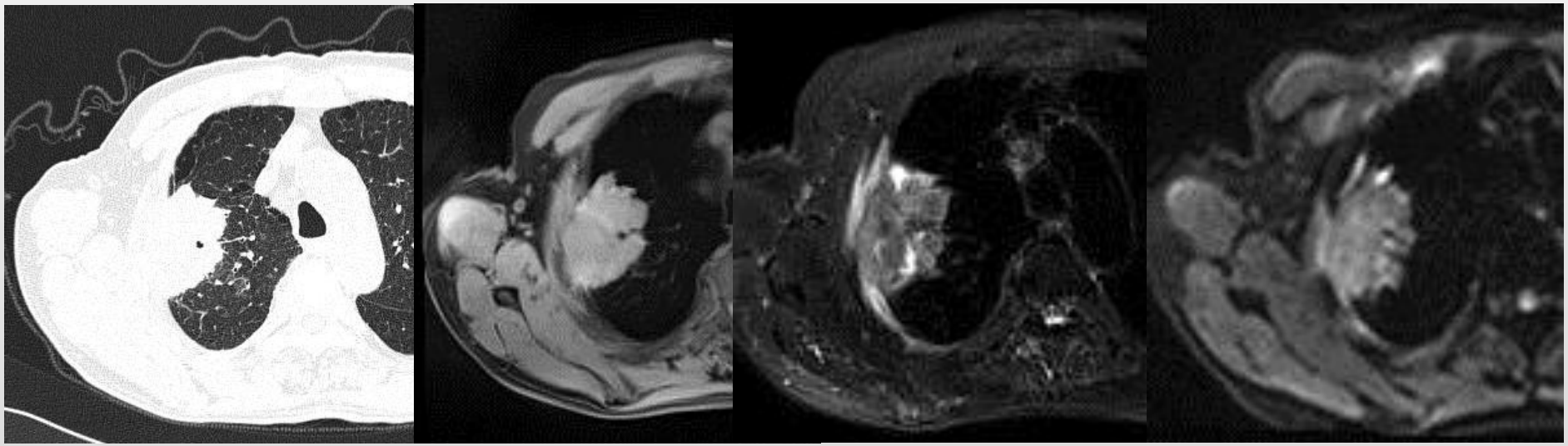
纤维化和钙化：



肺结节的鉴别诊断：

肺癌：

- 较大肺癌-信号混杂-出血、富细胞性、乏胞浆或坏死

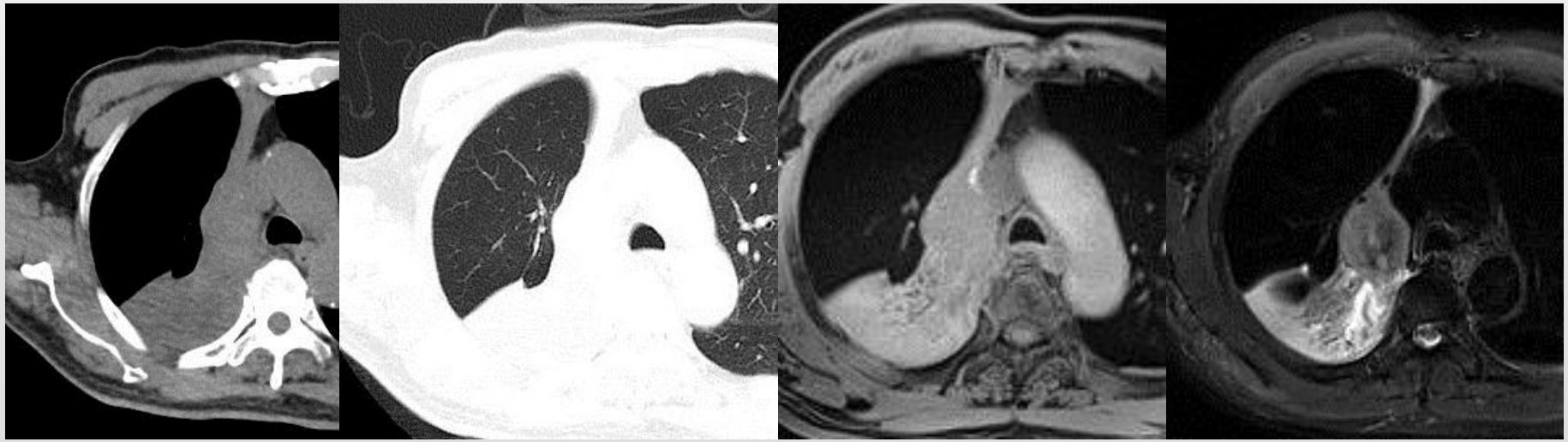


肺鳞癌

肺结节的鉴别诊断：

肺癌：

- 区分肿块与肺不张



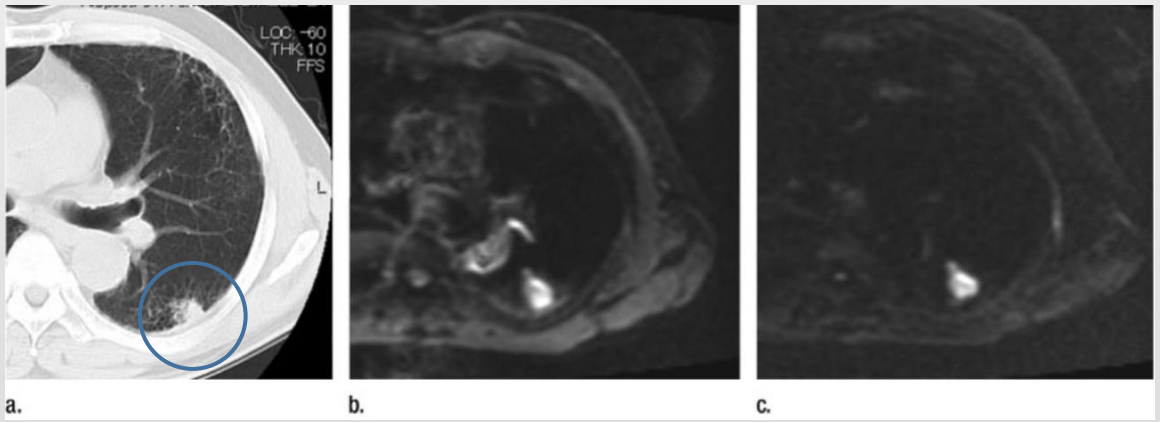
肺鳞癌

肺结节的鉴别诊断：

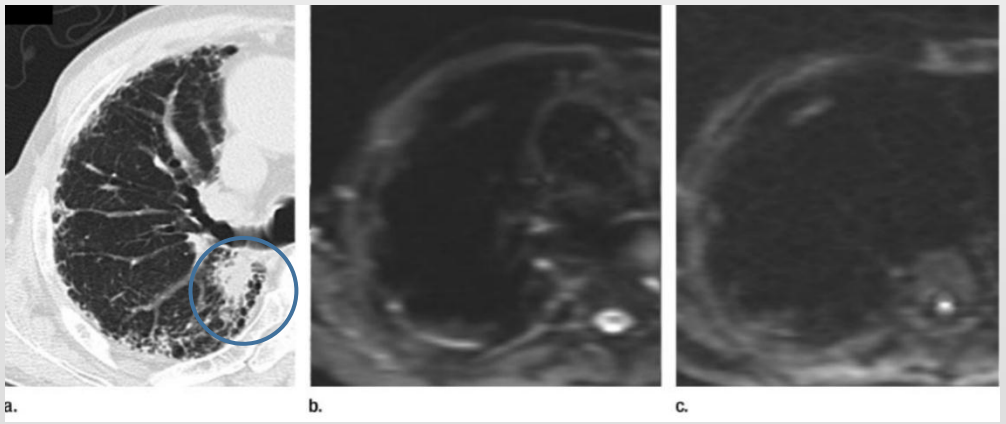
- 功能成像—— 扩散加权成像（DWI）

定量-ADC：<1.1-1.4×10^{-3} mm^2/s-敏感度70-83%，特异度74-97%

半定量-病灶与脊髓信号强度比值(LSR)：1.135-敏感度83%，特异度90%，准确度86%



62岁，男，SCLC

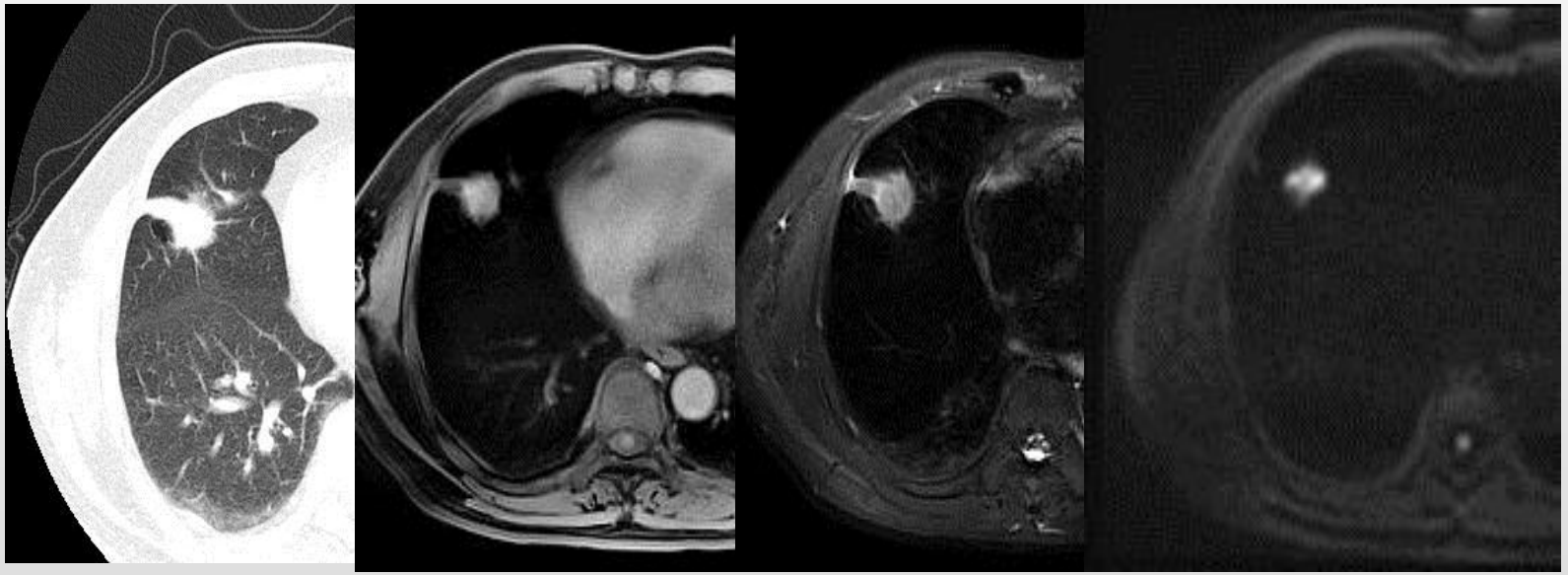


75岁，男，间质性肺炎

Uto T, et al. Radiology 2009;252:247-54.

肺结节的鉴别诊断：

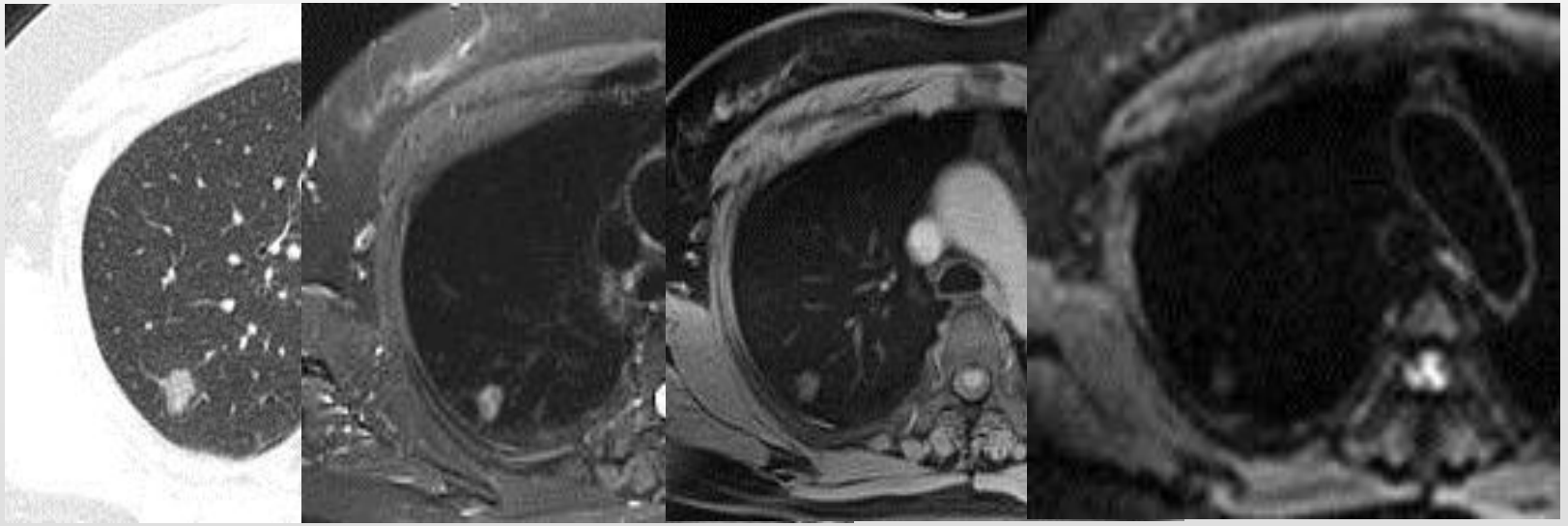
- 功能成像—— 扩散加权成像（DWI）



肺腺癌：手术证实

肺结节的鉴别诊断：

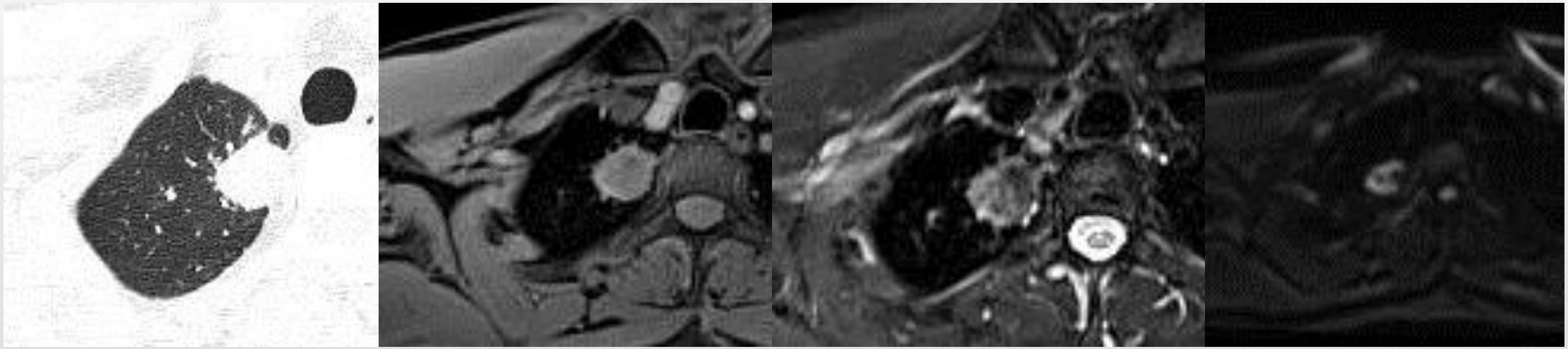
- 功能成像—— 扩散加权成像（DWI）



浸润性肺腺癌：手术证实

肺结节的鉴别诊断：

- 功能成像—— 扩散加权成像（DWI）



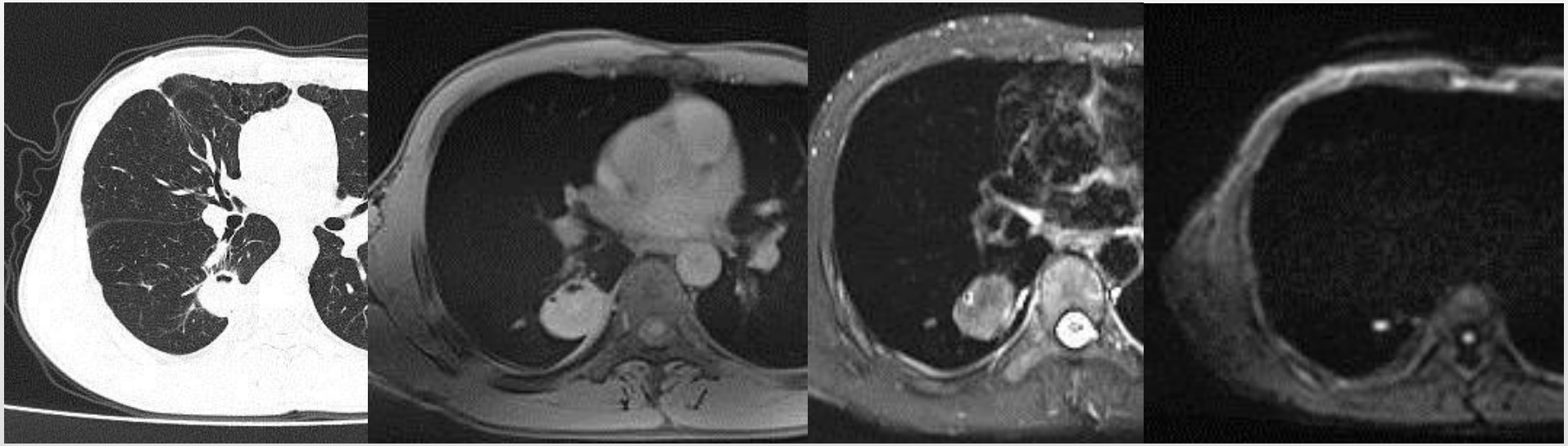
CT　　T1WI　　T2WI　　DWI

右肺上叶尖段结核球

上海市（复旦大学附属）公共卫生临床中心病例

肺结节的鉴别诊断：

- 功能成像—— 扩散加权成像（DWI）



CT　　T1WI　　T2WI　　DWI

右肺下叶背段结核球

上海市（复旦大学附属）公共卫生临床中心病例

肺结节的鉴别诊断：

- 功能成像—— 基于体素内不相干运动的扩散加权成像（ IVIM ）

TABLE 2. Comparison of Multi-parametric MRI Amount Three Qualitative Groups[a]

MR variable	SCC (n = 19)	Adeno-Ca (n = 29)	Malignancy (n=48)	BM (n = 48)
ADC(10^{-3} mm^2/s)	1.13± 0.28	1.19± 0.23	1.17±0.25	1.37 ±0.38[b]
D(10^{-3} mm^2/s)	1.02 ± 0.32	1.12 ± 0.35	1.09±0.34	1.34 ± 0.45[b]
D^b(10^{-3} mm^2/s)	14.99 ± 13.29	15.25 ± 10.09	14.14±39.77	12.81± 10.32
f(%)	26.37 ± 17.13	22.93 ± 21.77	23.37±20.0	25.95 ± 14.46
K^{trans} (min^{-1})	0.26 ± 0.08	0.24 ± 0.09	0.25±0.08	0.19 ± 0.08[b]

- D值-灵敏度91.3%；准确度72.2%；
- Ktrans-特异度84.6%
- D值+Ktrans-灵敏度94.2%；特异度92%；准确度93.5%

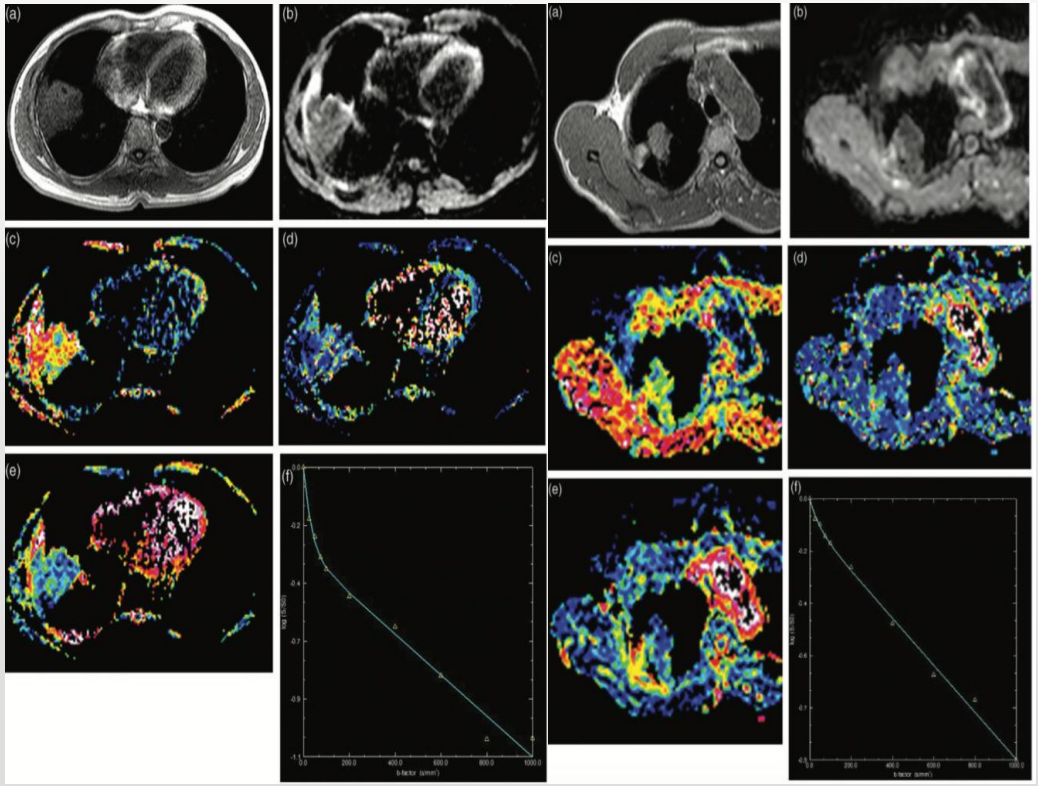
Yuan M, et al. J. MAGN. RESON. IMAGING 2016 Mar;43(3):669-679.

肺结节的鉴别诊断：

Table 2. Comparison of ADC and IVIM parameters between lung cancer and inflammatory lesions.

Parameters	Lung cancer ($n = 30$)	Inflammatory lesions ($n = 8$)	P value
ADC ($\times 10^{-3}$ mm^2/s)	0.97 ± 0.15	1.21 ± 0.20	0.004
D ($\times 10^{-3}$ mm^2/s)	0.65 ± 0.14	0.68 ± 0.18	0.747
D^* ($\times 10^{-3}$ mm^2/s)	32.73 ± 15.72	52.72 ± 35.19	0.124
f (%)	29.29 ± 10.89	46.10 ± 12.92	0.005

IVIM——f值：
肺癌与肺炎的鉴别诊断

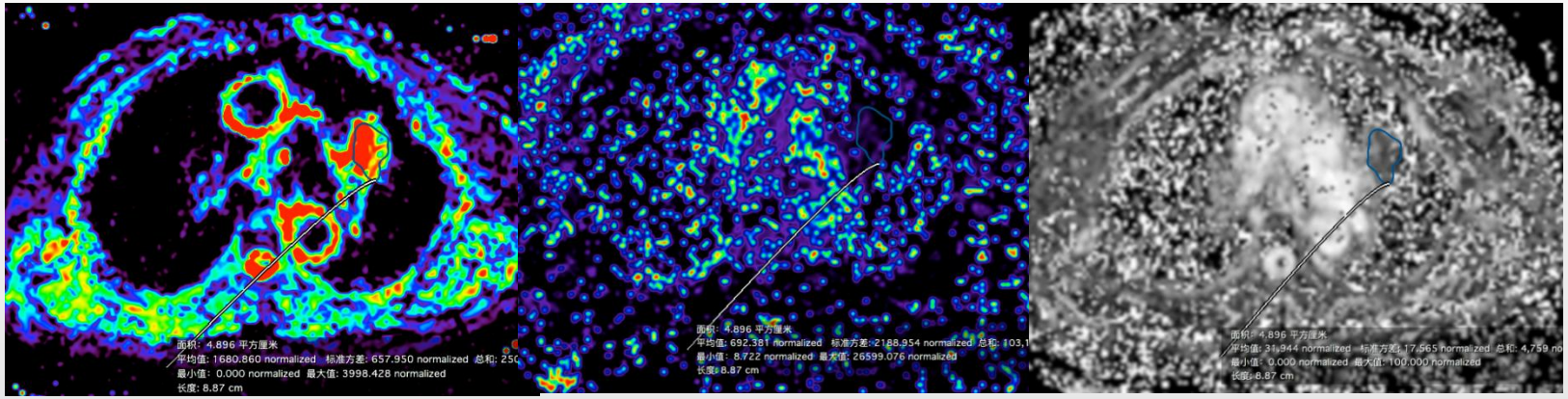


Deng Y, et al. Acta Radiol. 2015 May 13. pii: 0284185115586091.

49岁，男，机化性肺炎

39岁，男，腺癌

肺结节的鉴别诊断：

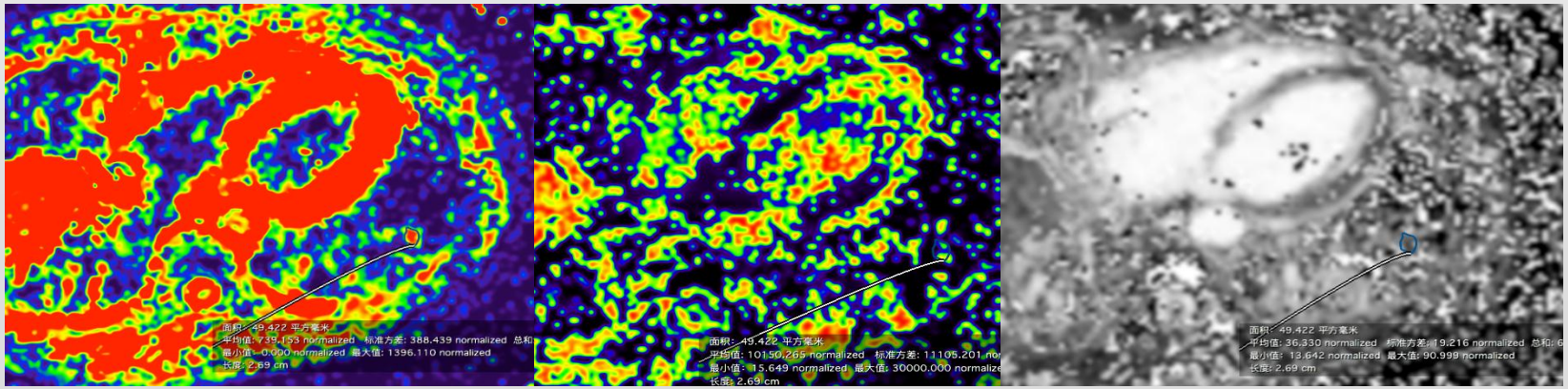


D：1.68×10^{-3} mm^2/s

D*：69.2×10-3 mm2/s

f：31.94%

72岁，女性，左肺上叶腺癌（手术证实）



D：0.739×10^{-3} mm^2/s

D*：1015×10^{-3} mm^2/s

f：36.33%

53岁，男性，HIV，左肺下叶外侧基底段结核球（手术证实）

肺结节的鉴别诊断：

- 功能成像—— 动态增强成像（DCE MRI）

与肺癌血管生成（微血管密度MVD）有关——

SI_{ep}、SI_{max}、SI_{ep}%、MER、上升Slope

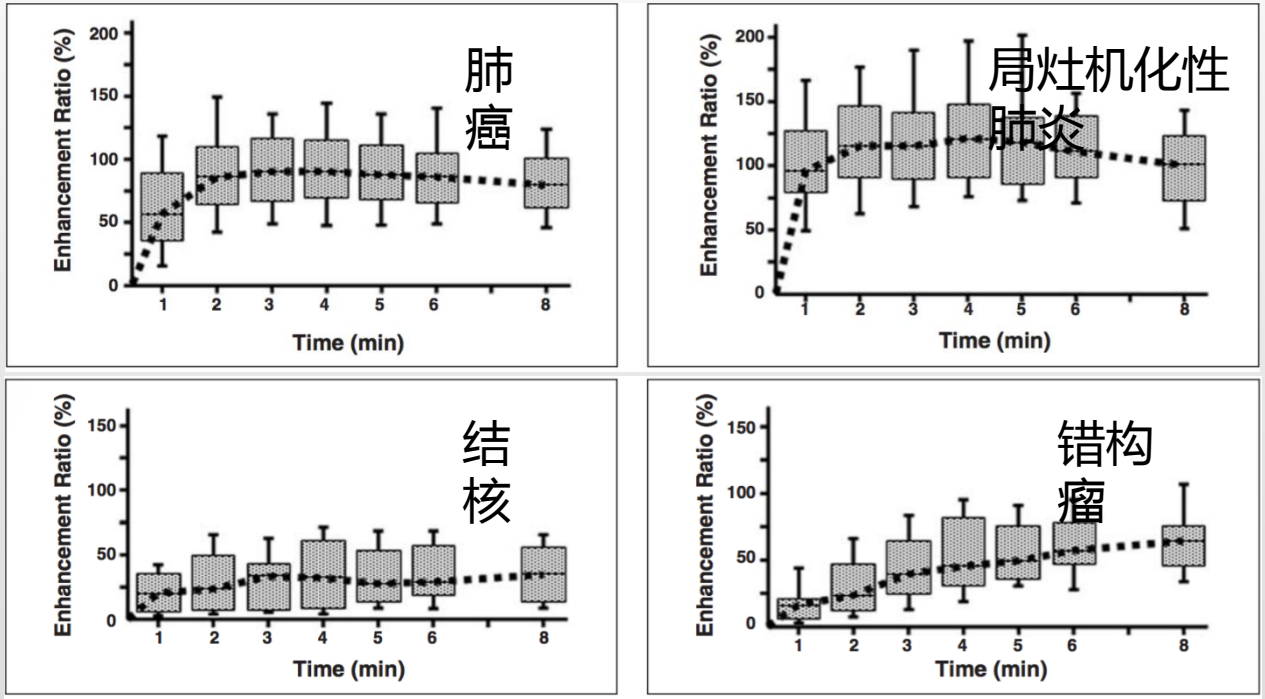
与肺癌的间质组成（纤维成分）有关——

washout、下降Slope

- 恶性结节或肿块-短时间内明显强化，最大强化峰值高，快速或逐渐廓清（机化性肺炎及炎性结节例外）
- 良性结节或肿块-强化程度低，造影剂廓清慢

Fujimoto, K., Usefulness of contrast-enhanced magnetic resonance imaging for evaluating solitary pulmonary nodules. Cancer Imaging, 2008. 8: p. 36-44.

肺结节的鉴别诊断：



良恶性结节、肿块鉴别-特异度和准确度较MDCT和PET-CT高

DCE-MR：灵敏度94-100%；特异度70-96%；准确度>88%

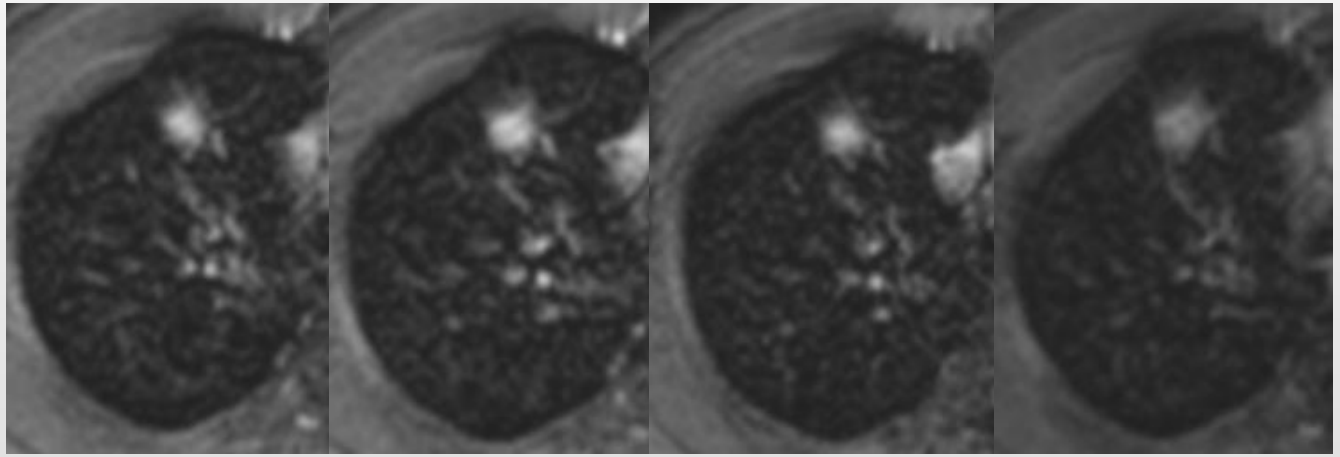
Meta分析：DCE-MR/CT/PET-CT/SPECT-良恶性结节鉴别无差异

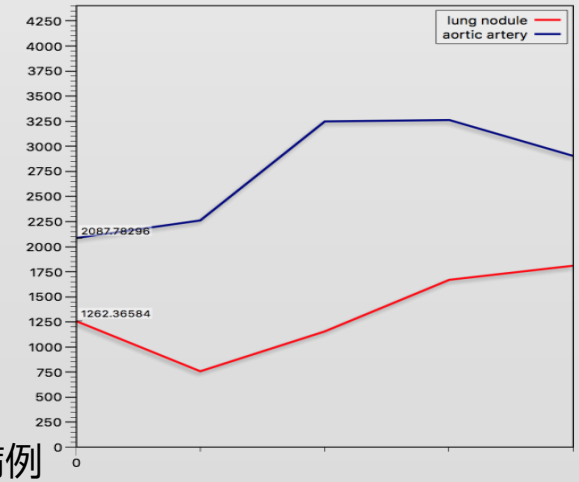
Koyama H, et al. Magnetic Resonance Imaging for Lung Cancer. J Thorac Imaging 2013;28:138–150.

Cronin P，et al. Solitary Pulmonary Nodules: Meta-analytic Comparison of Cross-sectional Imaging Modalities for Diagnosis of Malignancy. Radiology 2008; 246(3):772-782.

.Rei Kono, et al. Dynamic MRI of Solitary Pulmonary Nodules: Comparison of Enhancement Patterns of Malignant and Benign Small Peripheral Lung Lesions. *AJR* 2007; 188:26–36

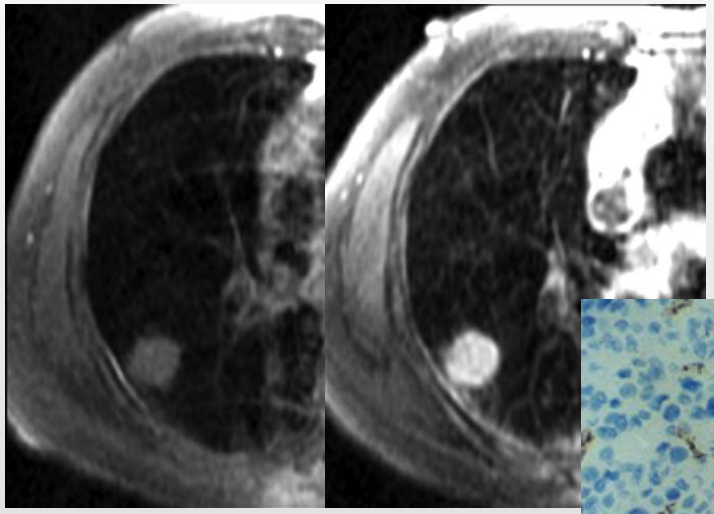
肺结节的鉴别诊断：





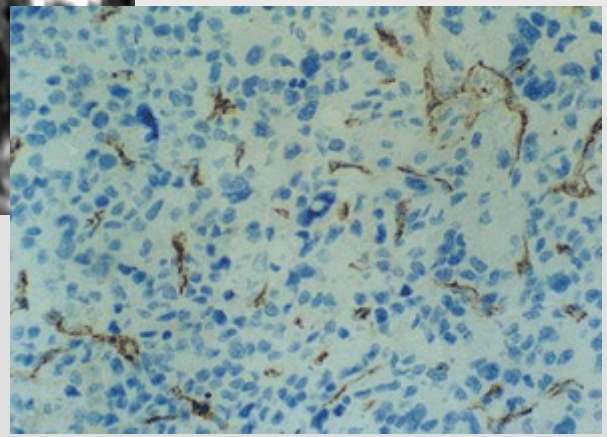
62岁，男
右肺上叶前段腺癌

肺结节的鉴别诊断：

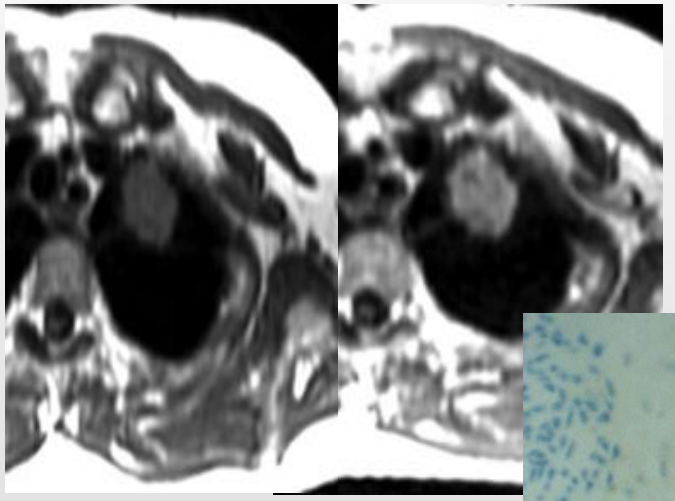


t=0s　　t=30s

肺腺癌

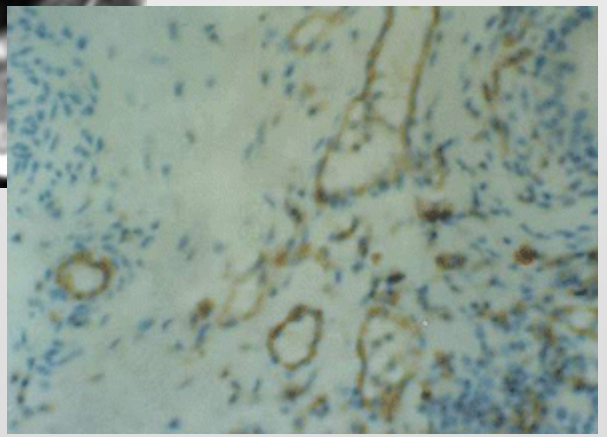


MVD



t=0s　　t=30s

结核球



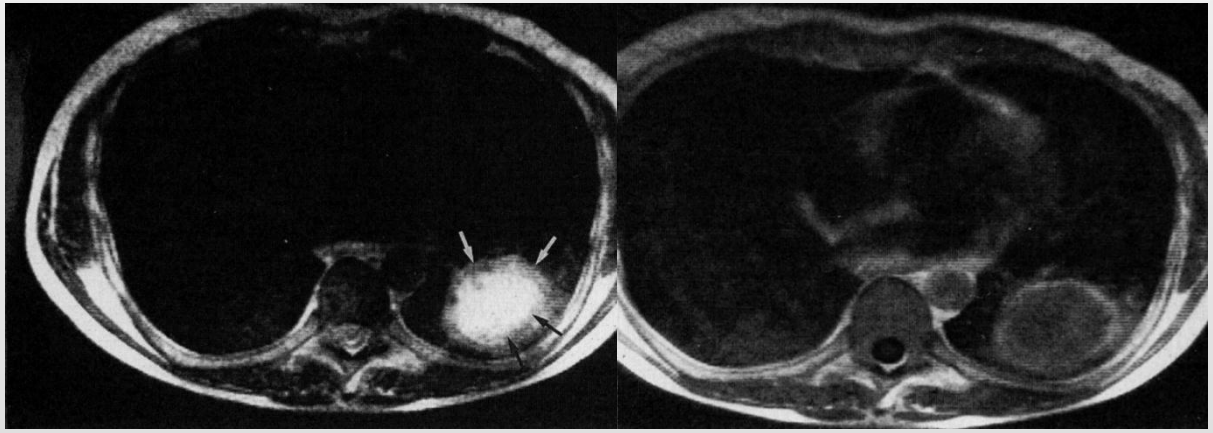
MVD

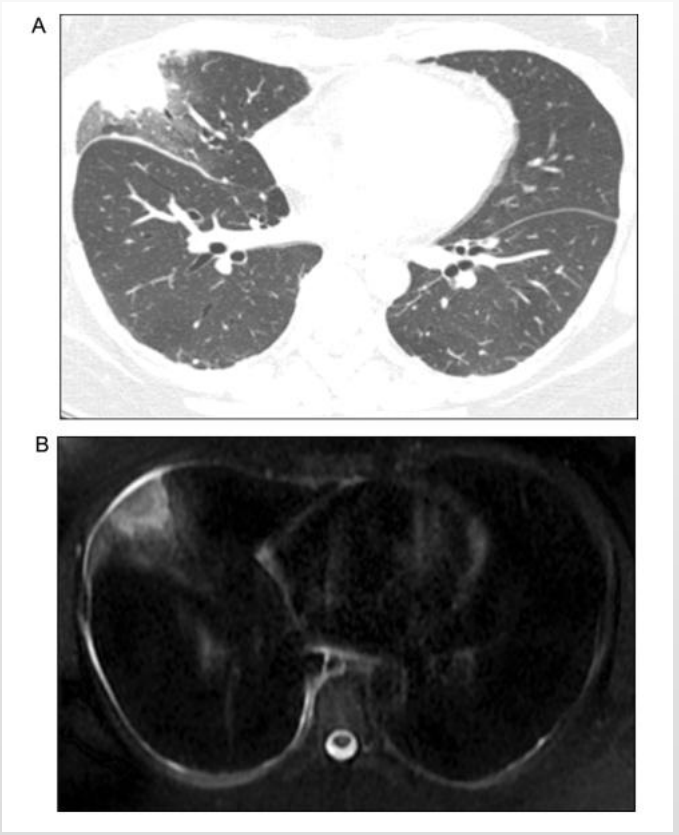
Zou, Y., et al., Quantitative investigation of solitary pulmonary nodules: dynamic contrast-enhanced MRI and histopathologic analysis. Ajr Am J Roentgenol, 2008. 191(1): p. 252.

肺结节的鉴别诊断：

肺曲霉菌病：

- MRI——晕征





Blum U, et al. Invasive pulmo- nary aspergillosis: MRI, CT, and plain radio- graphic ndings and their contribution for early diagnosis. Chest 1994; 106:1156–1161
Barreto, M.M., et al., Correlation between computed tomographic and magnetic resonance imaging findings of parenchymal lung diseases. Eur J Radiol, 2013. 82(9): p. e492-501.

肺结核MRI诊断价值

A

肺结核病变检出

>4mm以上病变，显示成分，

B

肺结核诊断

①不同病变阶段，定量化诊断；②鉴别诊断； ②II诊断不适合

C

肺结核治疗早期评估

首诊建议CT,复查提倡MR,尤其免疫低下患者；

复杂、耐药病例建议使用

谢谢观看