核医学在呼吸系统疾病中临床应用

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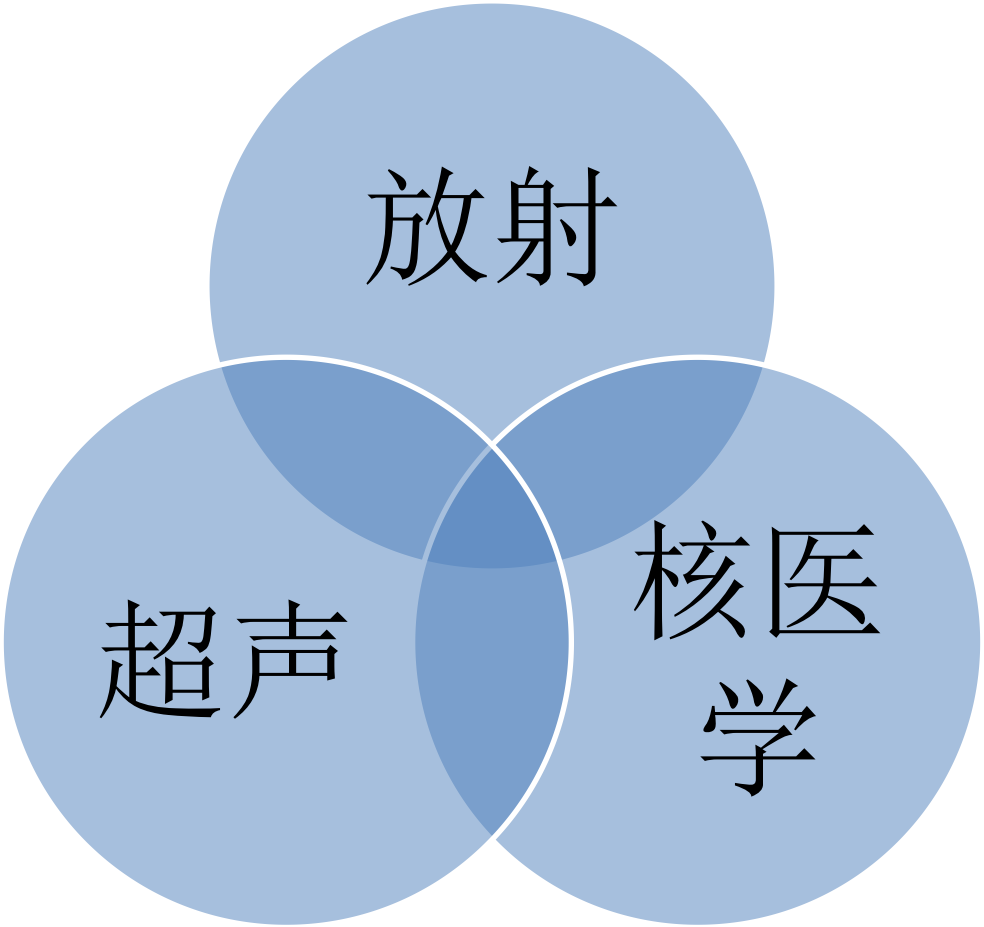
核医学是什么

- 是核技术在医学中应用（诊断、治疗及机制）及其理论的学科
- 是和平利用核能的重要组成部分
- 核素显像是医学影像学的重要组成部分
- Nuclear M---Unclear M—New Clear M

医学影像学



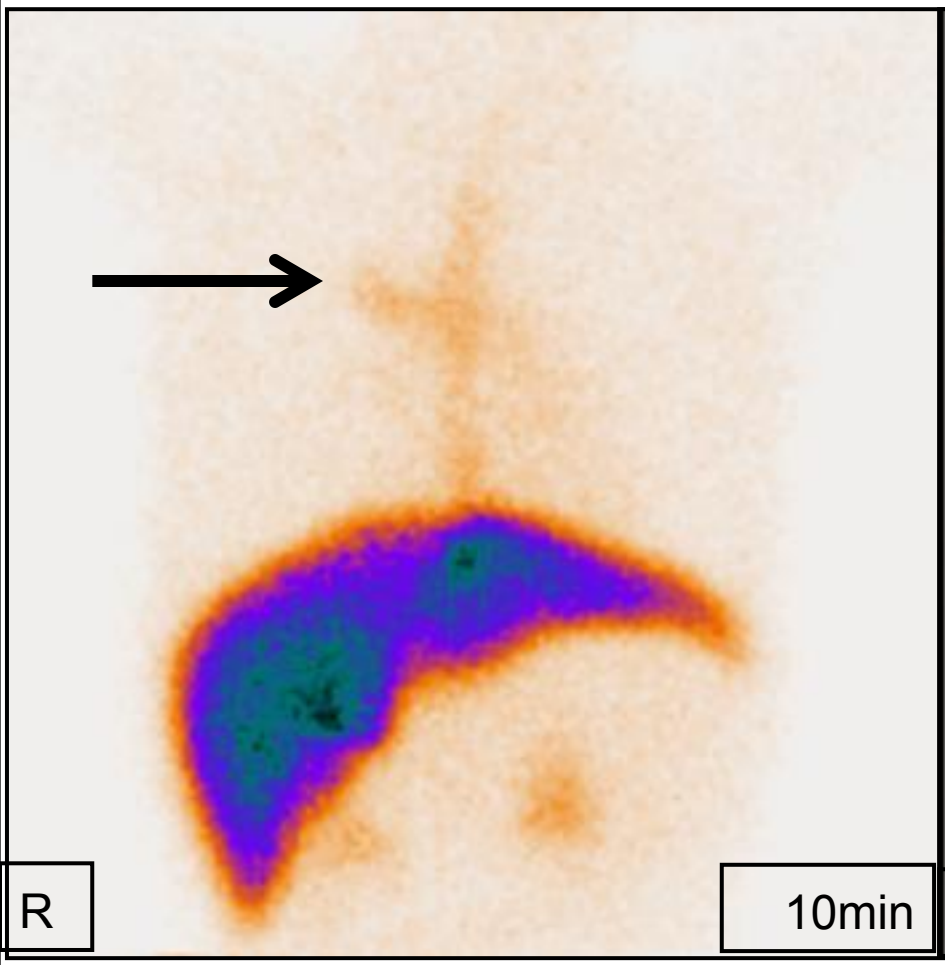
核医学影像同与不同

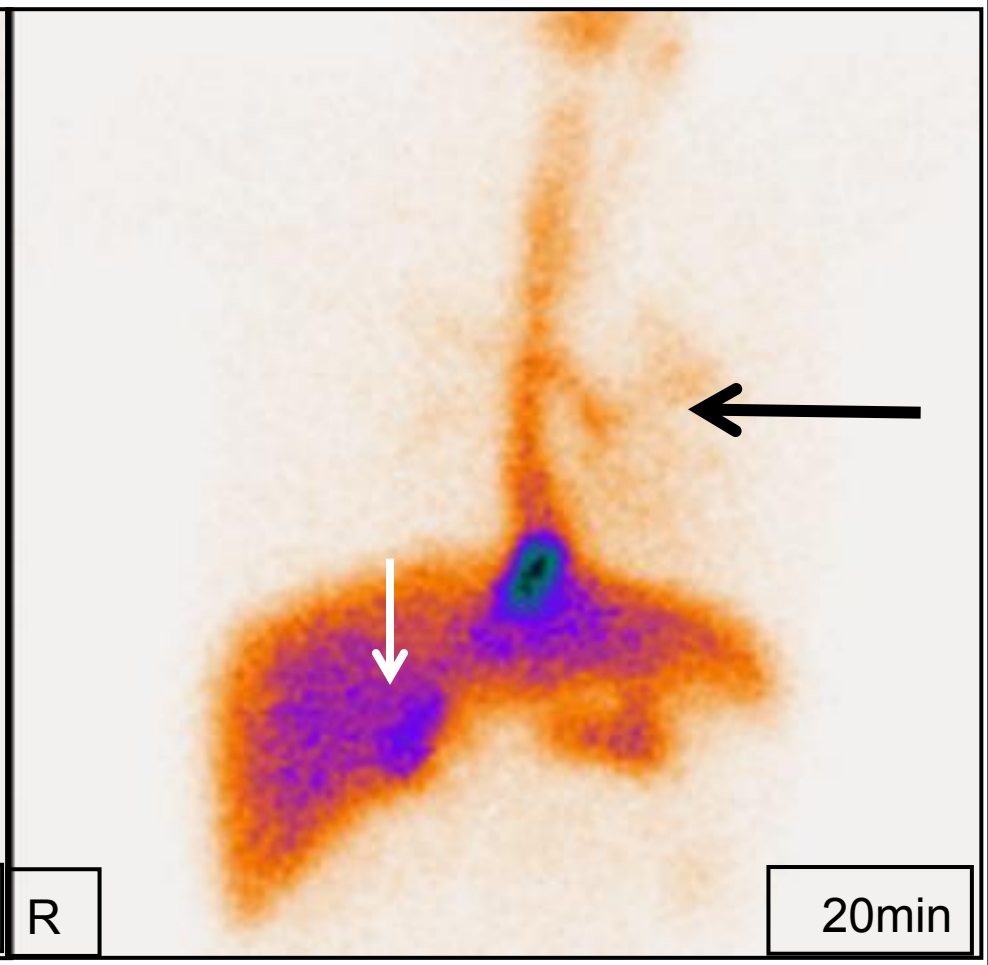
- 都需要设备，必须用“药”
- -99mTc-MDP 全身骨扫描
- -99mTc-MIBI心肌灌注显像
- -99mTc-MAA 肺灌注显像+99mTc-Technegas 肺通气显像
- -99mTc-DTPA 肾动态显像
- -……VS“一样”的增强剂
- 不是解剖影像，是功能、是代谢影像
- 只能给活体做检查
- 追求特异性胜过分辨率
- 做检查的时间漫长
- 最不普及

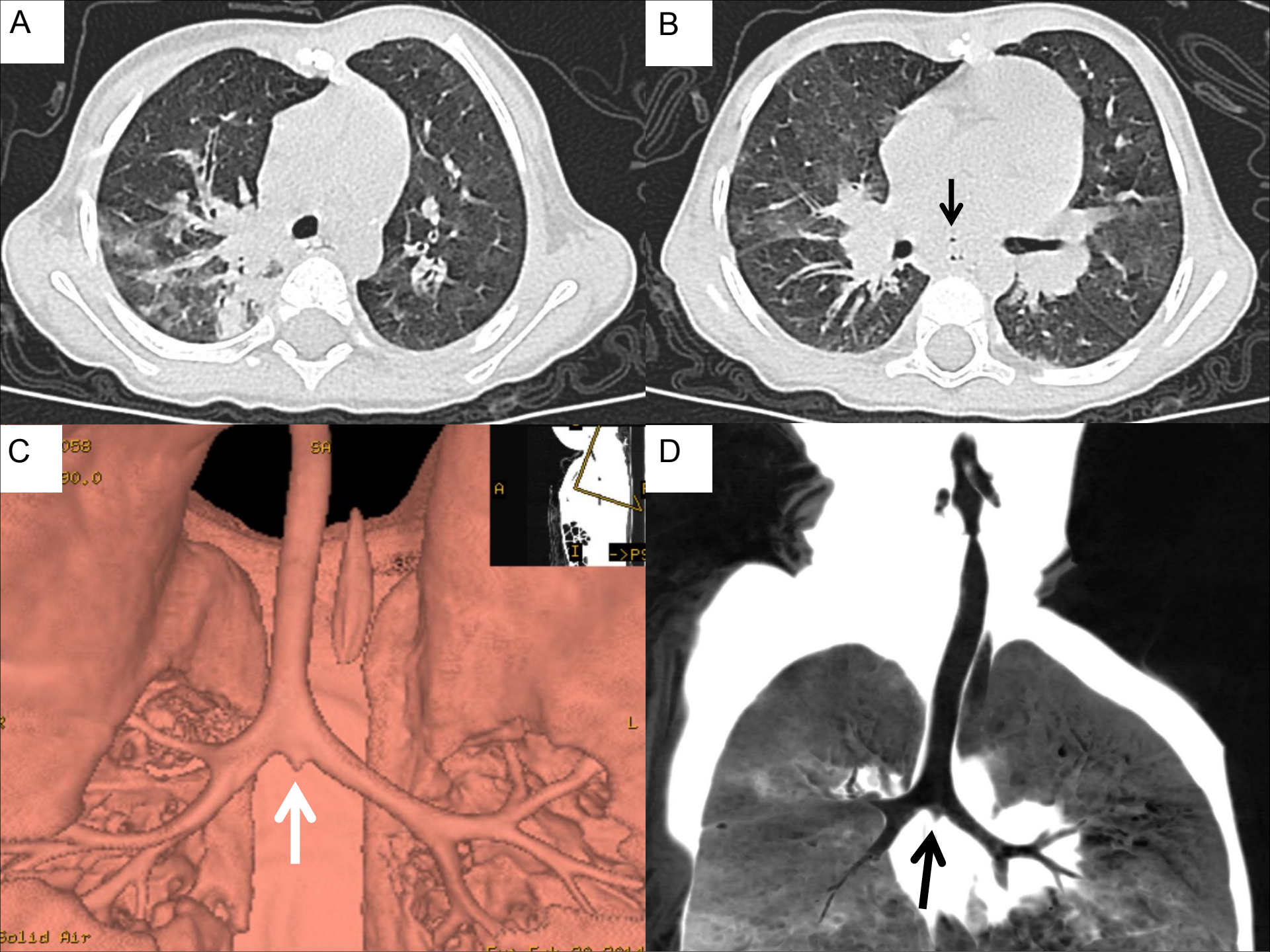
核医学的特色

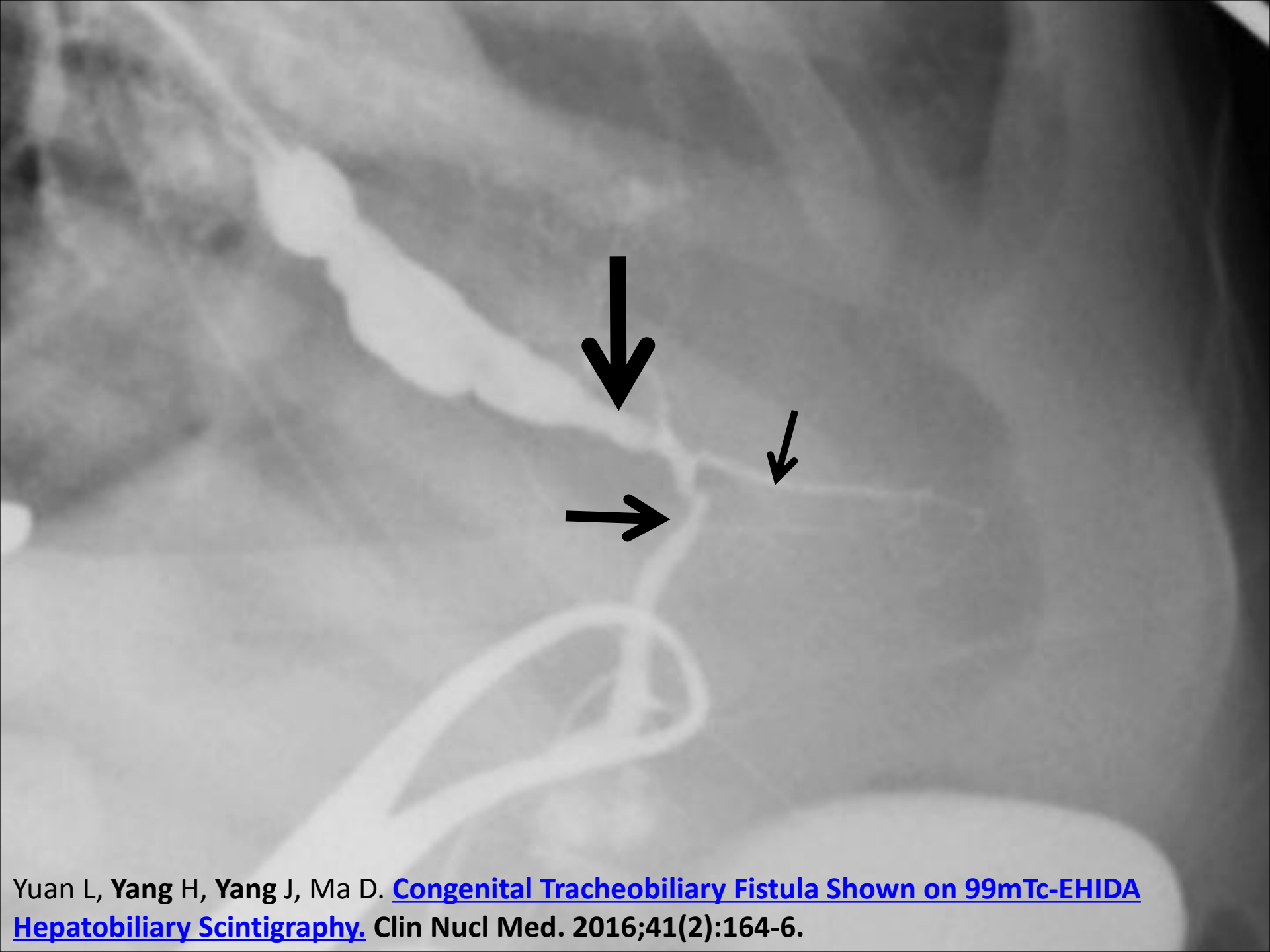
- 放射性核素示踪技术
  - 是核医学的技术基础
  - 是核医学的精髓

Case






A
B
C
D
L
Solid Air



Yuan L, **Yang** H, **Yang** J, Ma D. Congenital Tracheobiliary Fistula Shown on 99mTc-EHIDA Hepatobiliary Scintigraphy. **Clin Nucl Med. 2016;41(2):164-6.**

核医学诊疗项目

◆核医学显像

✓ PET/CT

- 18F-FDG PET/CT、68Ga-奥曲肽 PET/CT、68Ga-PSMA PET/CT

✓ SPECT或SPECT/CT

- 全身骨扫描（99mTc-MDP）、腮腺动态扫描（99mTcO4-）、肾动态（99mTc-DTPA）、心肌灌注（99mTc-MIBI）、131I-MIBG扫描
- 123I-MIBG扫描

◆核医学治疗

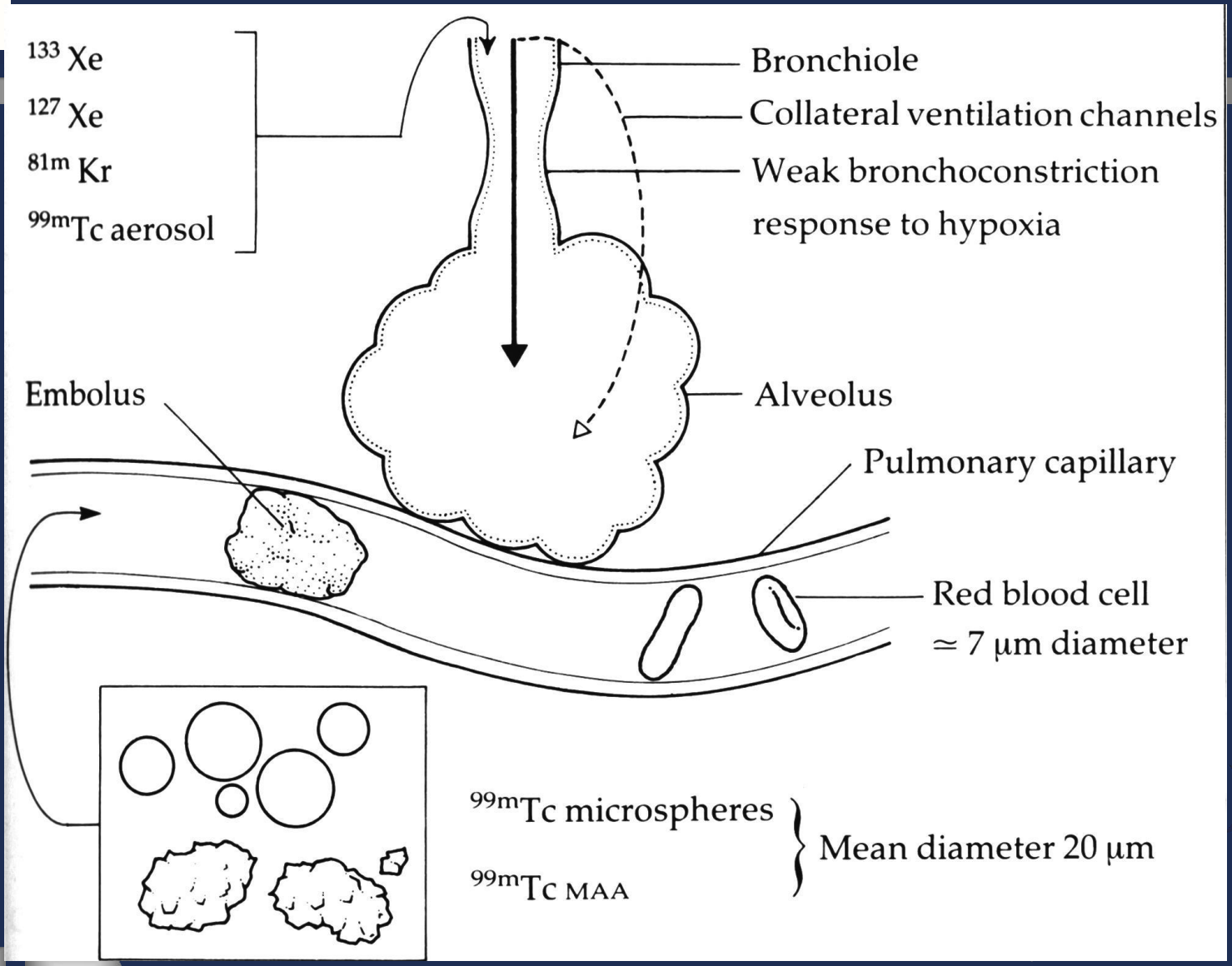
- 放射性核素治疗：131I治疗甲亢、甲癌、89Sr治疗骨转移
- 99Tc-MDP（云克）治疗RA：不是放射性核素

SPECT/CT

SPECT/CT

- ✓肺灌注显像+肺通气显像
  - ✓灌注与通气血流比
- ✓全身骨扫描
  - ✓腮腺摄取和排泄的功能
- ✓肾动态显像
  - ✓肾脏功能.....

示意图


^{133}Xe
^{127}Xe
^{81m}Kr
^{99m}Tc aerosol
Bronchiole
Collateral ventilation channels
Weak bronchoconstriction
response to hypoxia
Embolus
Alveolus
Pulmonary capillary
Red blood cell
≃ 7 μm diameter
^{99m}Tc microspheres
^{99m}Tc MAA
Mean diameter 20 μm

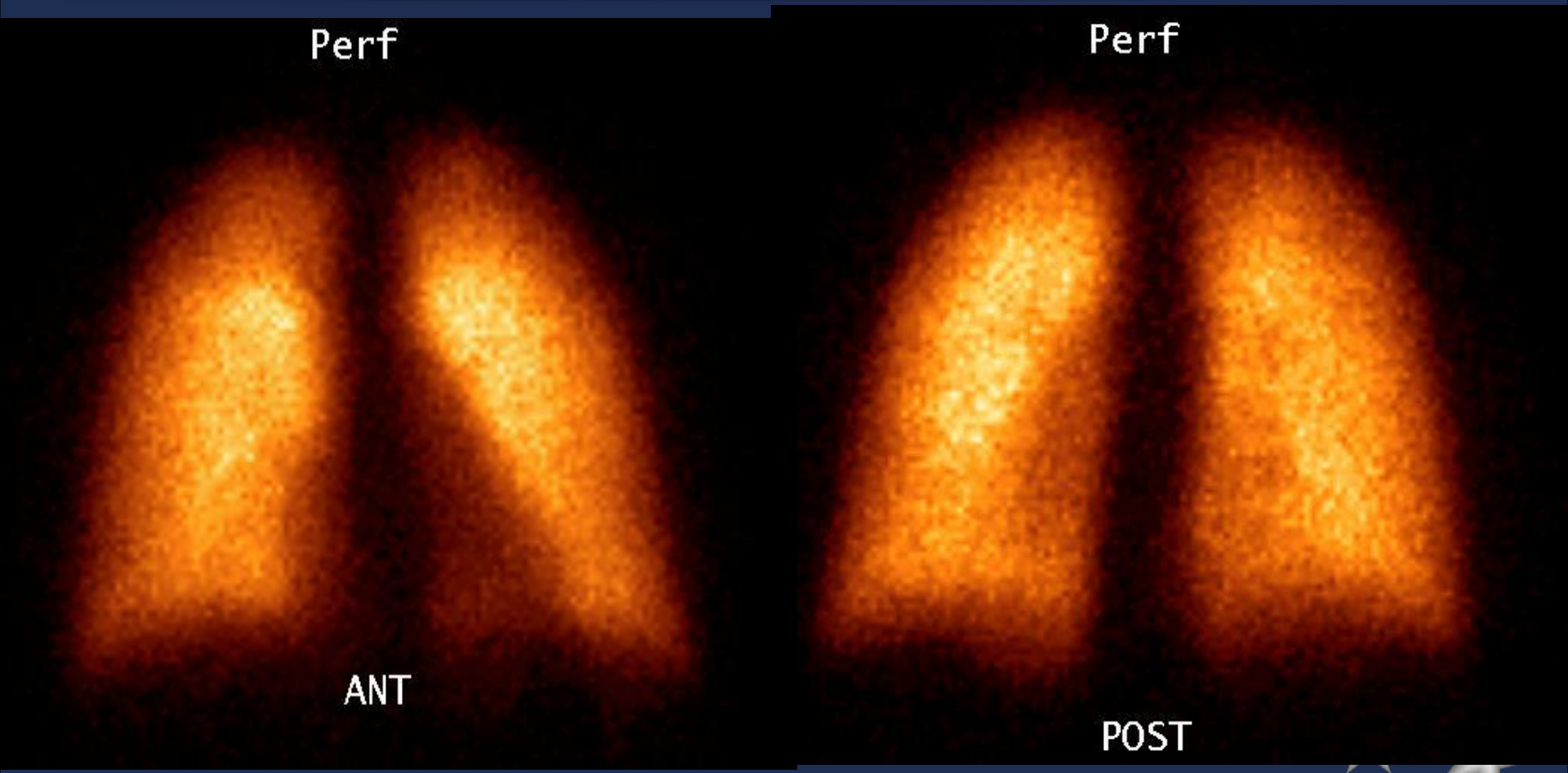
肺血流灌注显像的原理

- 放射性颗粒(10-60μm)随血流经肺动脉到达并一过性嵌顿在肺毛细血管(7-9μm),^{99m}Tc-MAA
- 颗粒在肺内分布的量与肺血流量呈正比
- 探测肺部放射性活度可反映局部肺灌注情况

肺血流灌注显像的安全问题

- 一次注射20~70万个颗粒，栓塞1/1500毛细血管
- 蛋白颗粒在体内很快（$T_{1/2}$:2-6h）降解成更小的分子，被吞噬细胞清除
- 一般不引起心肺血液动力学改变，是安全的
- 但右→左分流的患者，颗粒进入大循环引起心、脑、肾血管栓塞，应慎（禁）用

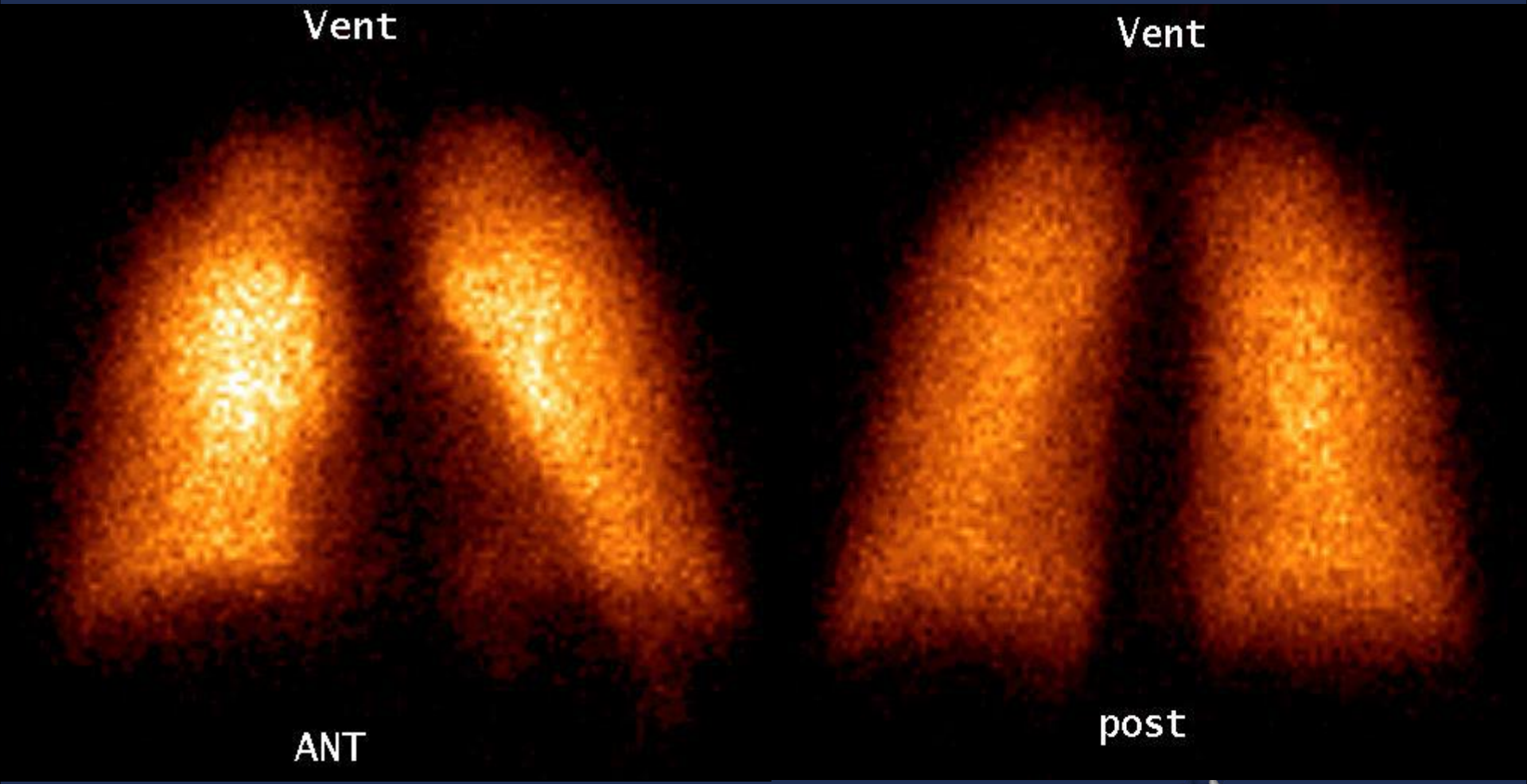
肺灌注显像正常图像



肺通气显像原理

- 放射性气体、锝碳气体或气溶胶经呼吸道吸入
- 显像剂在肺内的分布与肺的局部通气量呈正比
- 反映的是肺内局部的通气状况

肺通气显像正常影像所见



肺显像的临床应用

- 肺栓塞的诊断与疗效观察
- 肺部手术前估计术后肺功能
- 慢性阻塞性肺部疾患
- 肺动脉高压

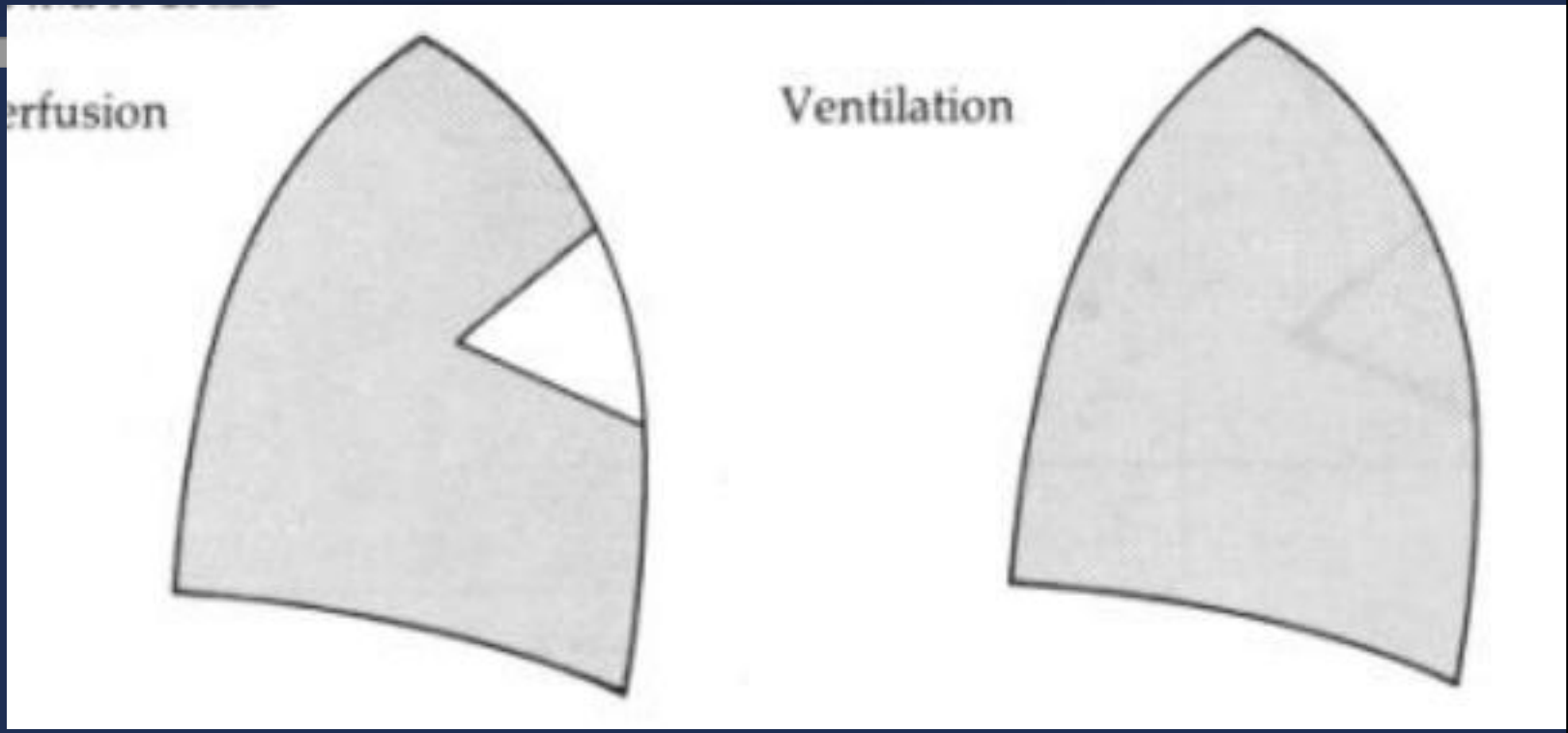
肺血栓栓塞（PTE）的临床

- PTE是各种栓子阻塞肺动脉系统引起的一组疾病总称
- 早诊断，早治疗降低死亡率
- 肺栓塞99%由血栓引起，70%来自下肢深静脉血栓，还有瘤栓、脂肪栓子、羊水、空气等
- 近期有外伤、手术及长途旅行史，既往患有血栓性静脉炎、静脉曲张。

辅助检查

- 胸部X片主要肺纹理减少，透亮度增高；
- 心电图发生改变70%， 非特异性
- V/Q显像是PE最重要的诊断方法之一，V/Q匹配关系
- 肺动脉造影是金标准，肺动脉内充盈缺损，有创
- CT：肺动脉内充盈缺损；楔形密度增高影
- MRI：血管腔内条形异常信号，而血管轮廓多无异常。

肺栓塞的V/Q示意图

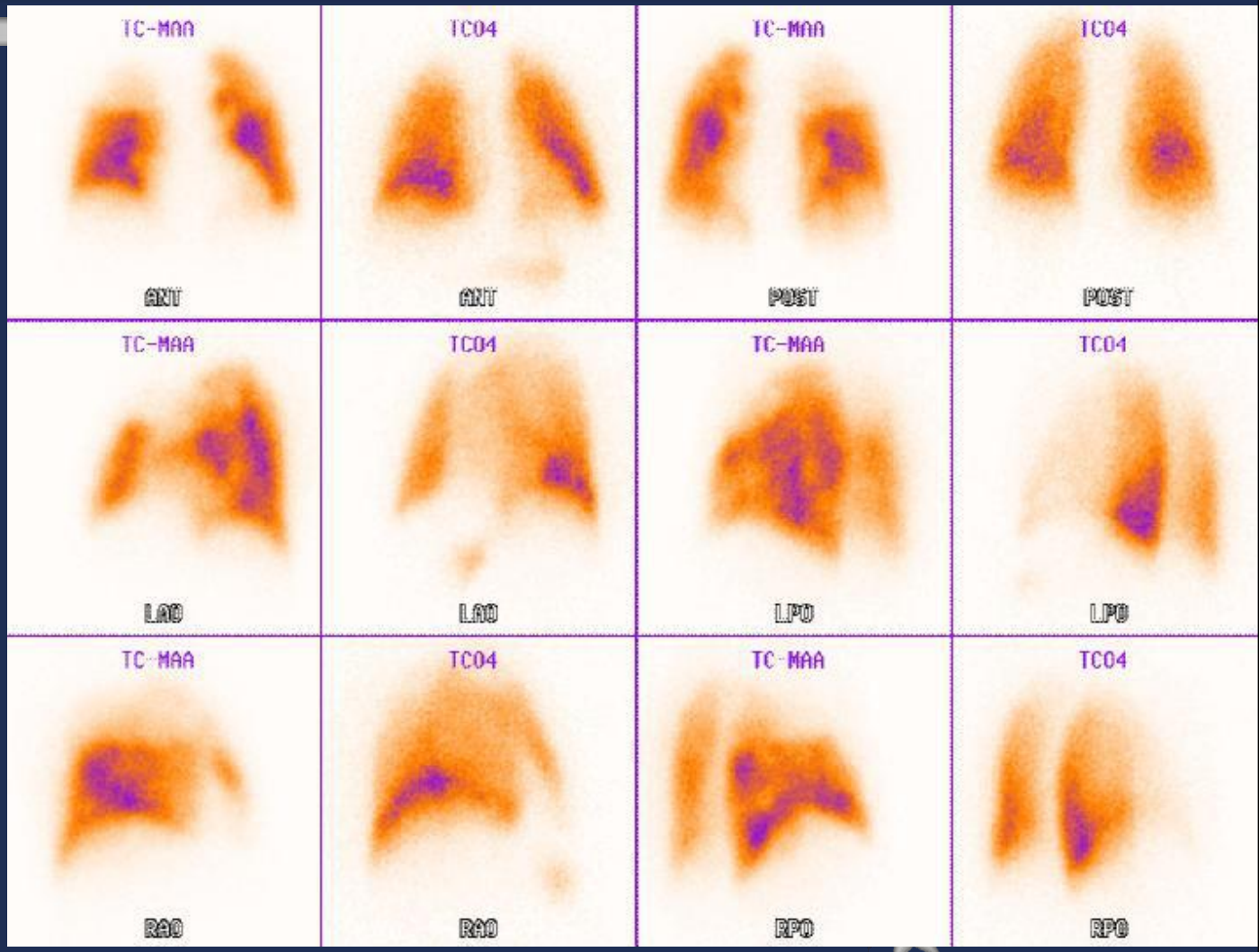


- 灌注-缺损
- 通气-正常

} 不匹配(mismatch)

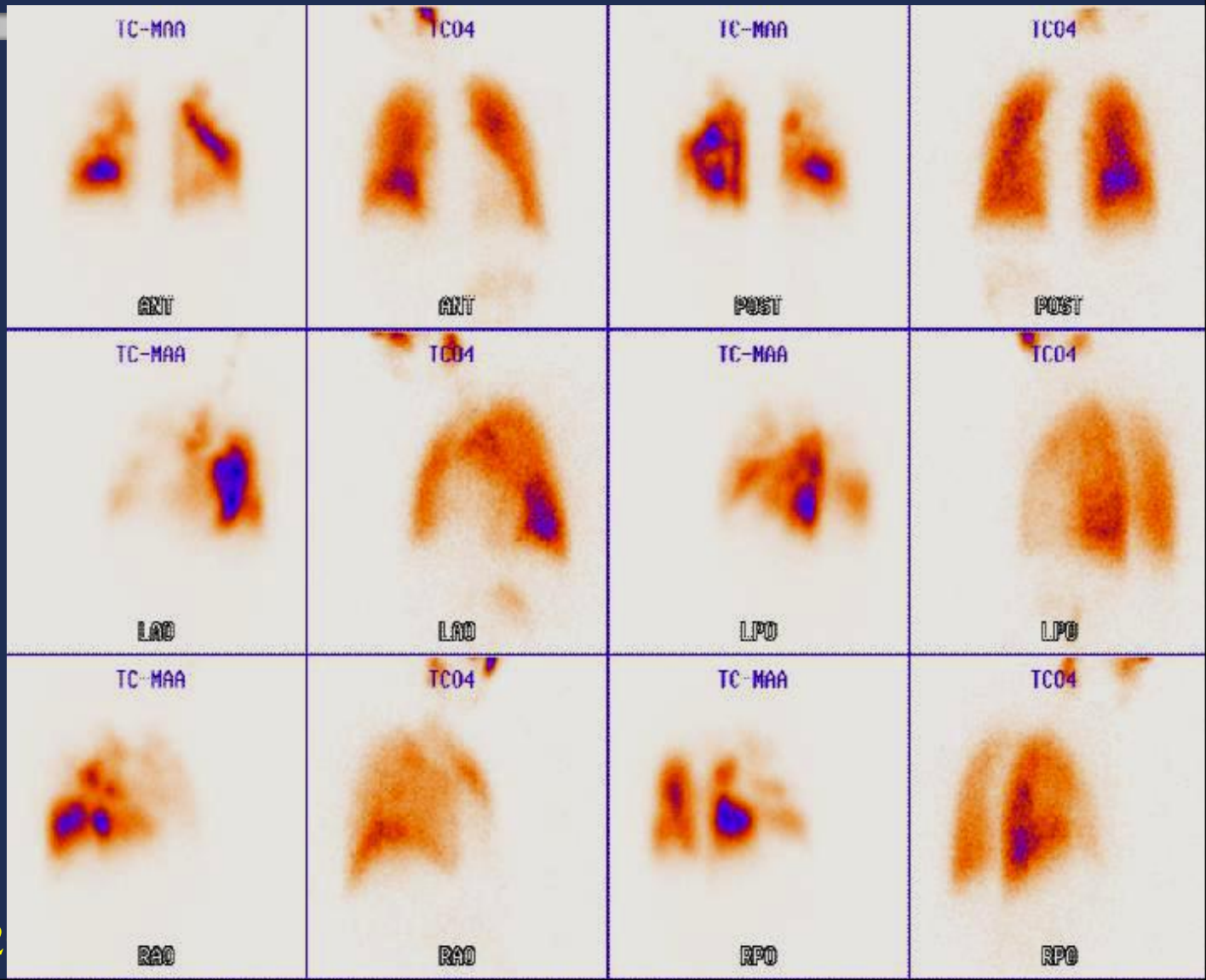
肺栓塞的影像

- 肺灌注显像
- 肺通气显像
- 肺叶栓塞

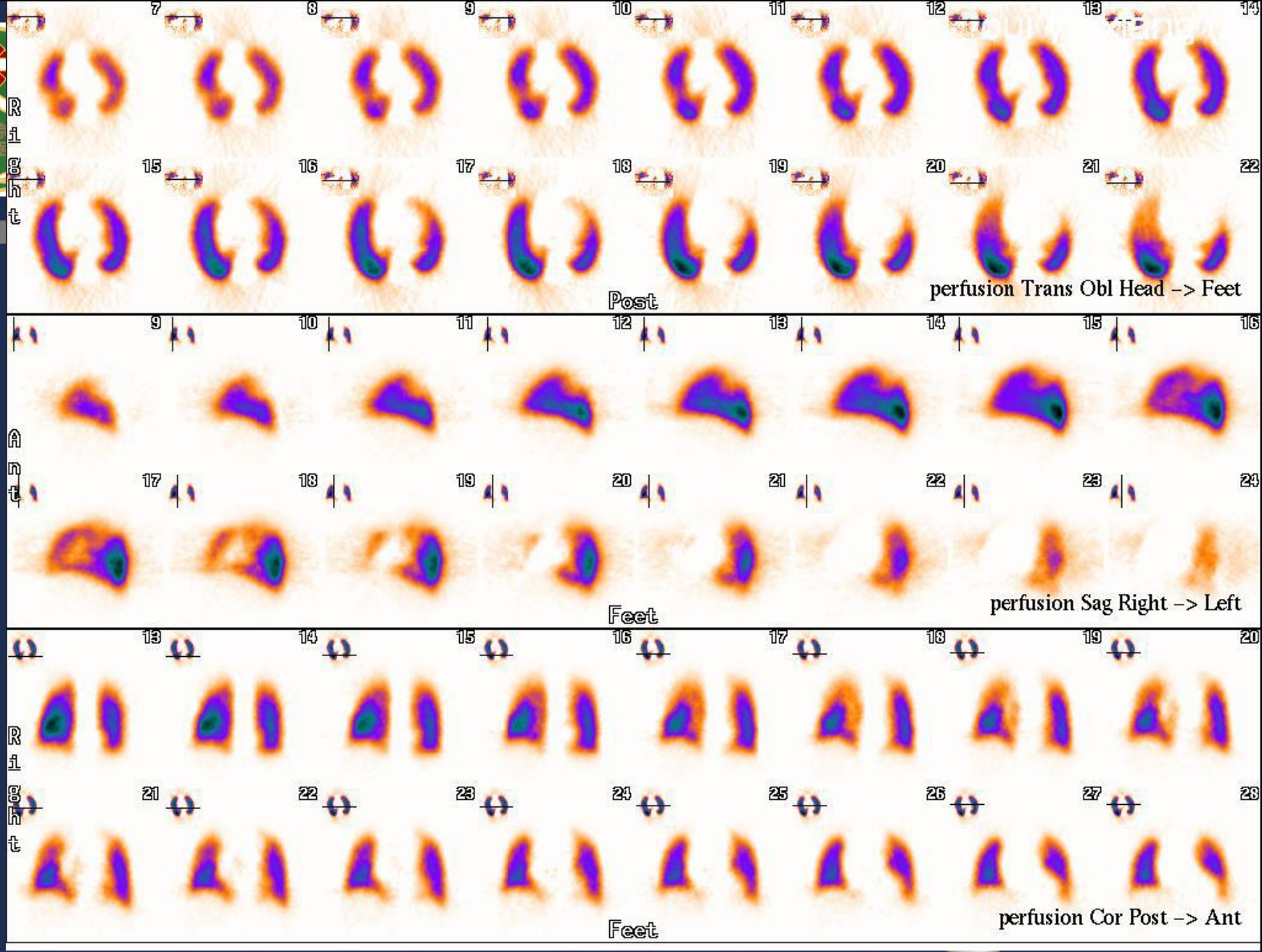


肺栓塞的影像

- 肺灌注显像
- 肺通气显像
- 多个肺段栓塞



SPECT断层显像


Right
Post
perfusion Trans Obl Head -> Feet
Ant
Feet
perfusion Sag Right -> Left
Right
Feet
perfusion Cor Post -> Ant

SPECT和平面显像的比较

Collart et al. also demonstrated that SPECT was more specific than planar imaging (96% vs. 78%);

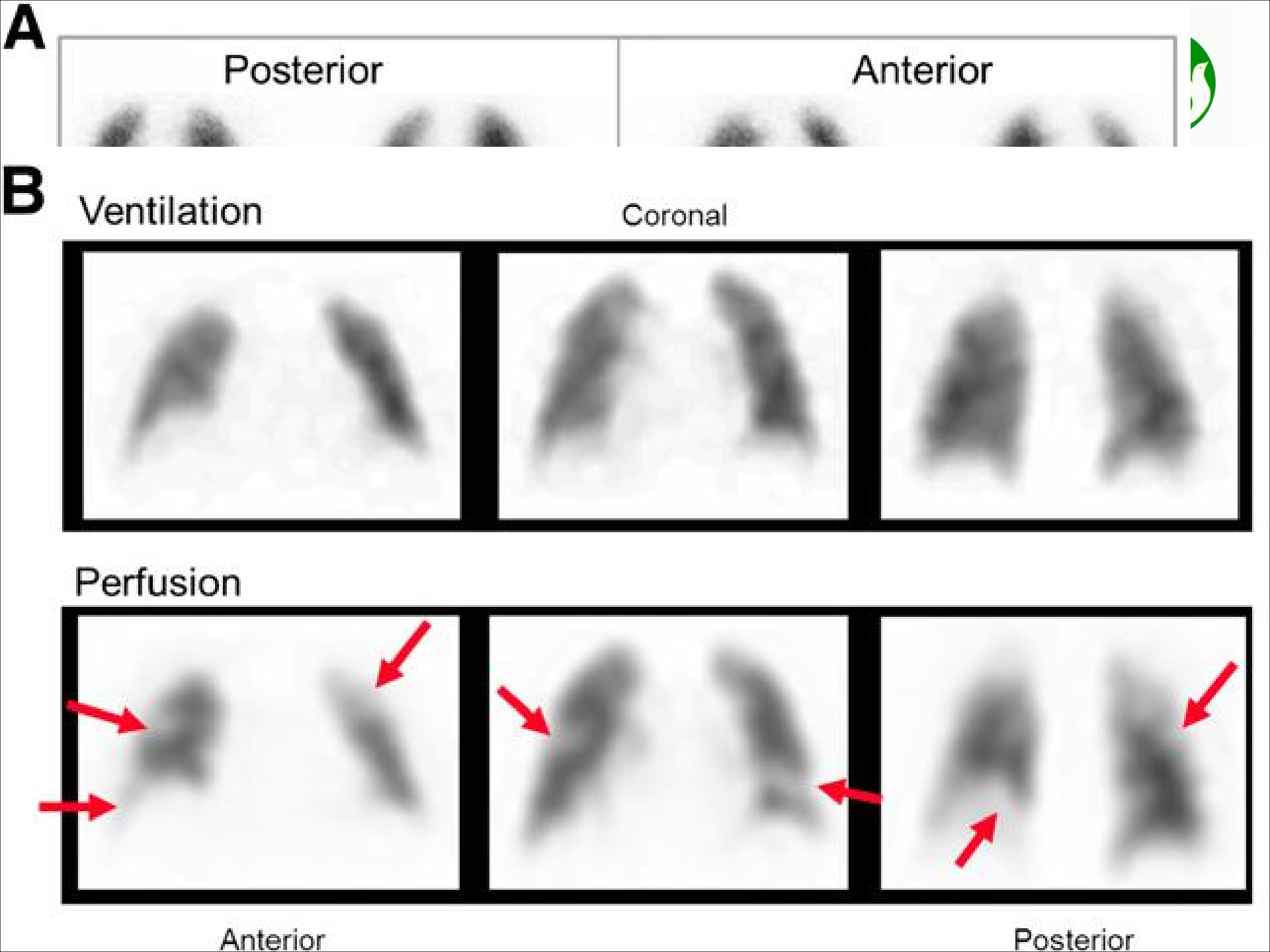
better reproducibility;

both intraobserver (94% vs. 91%);

and interobserver (88% vs. 79%).

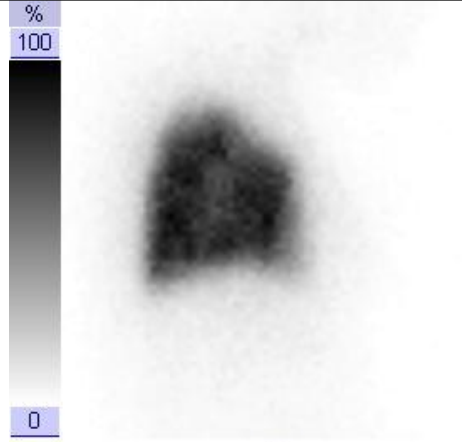
Summary of Strengths and Limitations of CTPA, V/Q SPECT, and V/Q SPECT/CT

Parameter	CTPA	V/Q SPECT	V/Q SPECT/CT
Sensitivity	Moderate-high	High	High
Specificity	Very high	High	Very high
Accuracy with abnormal radiograph finding	Unaffected	Sometimes affected	Sometimes affected
Ability to provide other diagnoses	Frequent	Rare	Frequent
Incidental findings requiring follow-up	Frequent	Rare	Less frequent
Radiation dose	High	Low	Low-moderate
Possible allergic reaction	Yes	No	No
Risk of contrast nephropathy	Yes	No	No
Technical failure rate	Higher	Rare	Rare
Availability (especially outside routine hours)	High	Usually lower	Usually lower
Accuracy in pregnancy	Lower	High	High
Accuracy in chronic PE	Lower	High	High
Performance in obstructive lung disease	Unaffected	May be affected	May be affected
Role and accuracy in follow-up	Limited	Very good	Very good

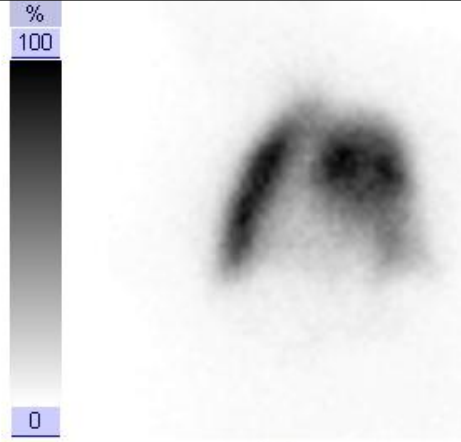

A
Posterior
Anterior
B
Ventilation
Coronal
Perfusion
Anterior
Posterior

Case

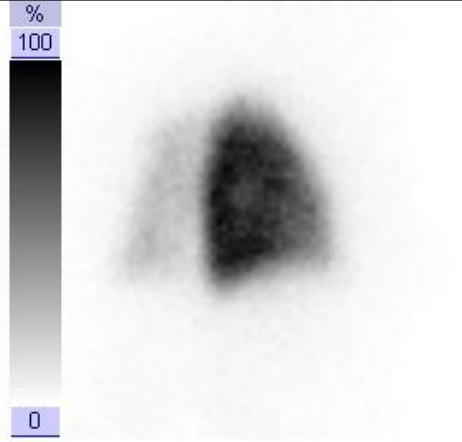
- ✓刘*，00397393
  - ✓妊娠31+6周 孕5产0
  - ✓臀位
  - ✓子痫前期重度
  - ✓抗磷脂抗体综合征
  - ✓易栓症
  - ✓辅助生育术后
  - ✓不良孕史
  - ✓胎儿宝贵



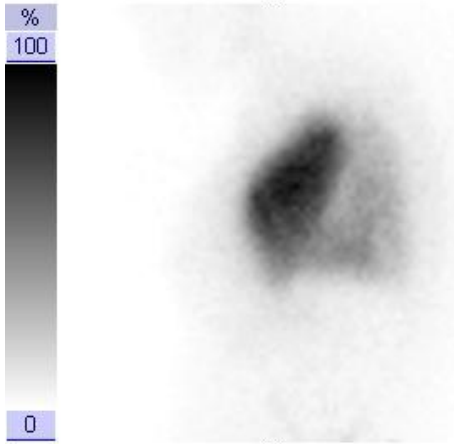
RR



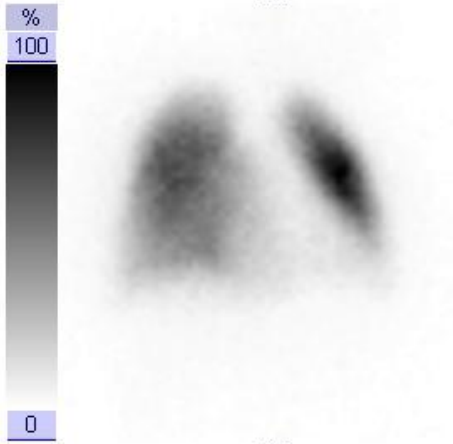
LAO



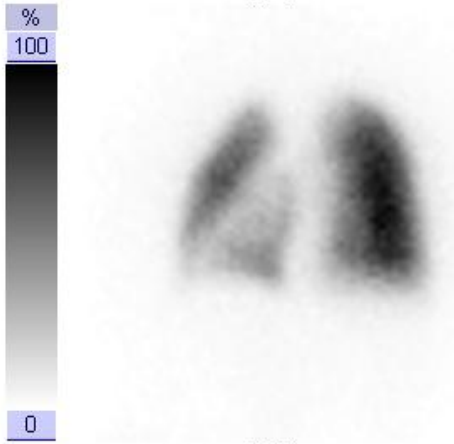
RPO



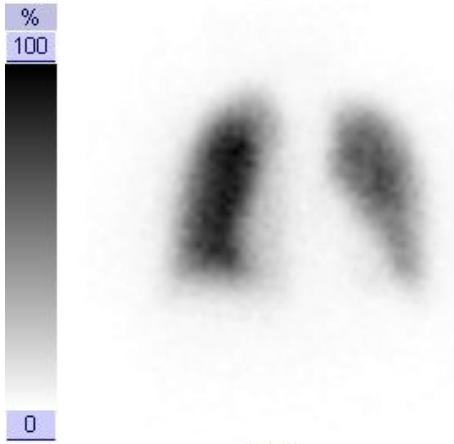
LL



RAO



LPO



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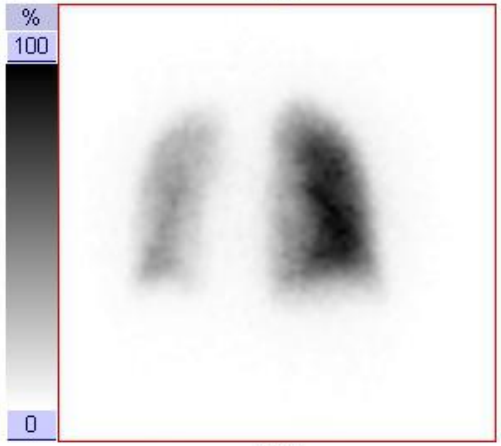
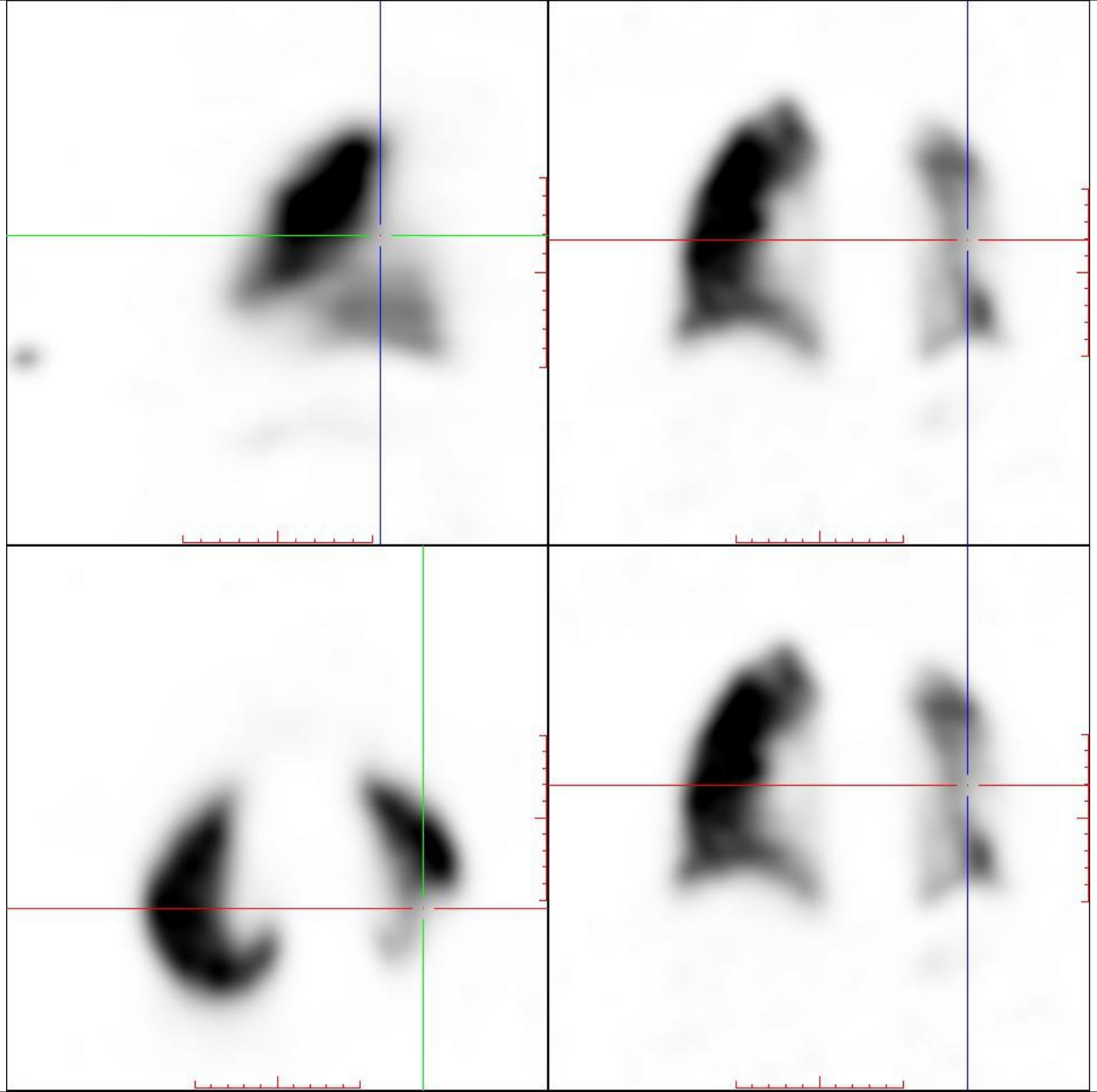
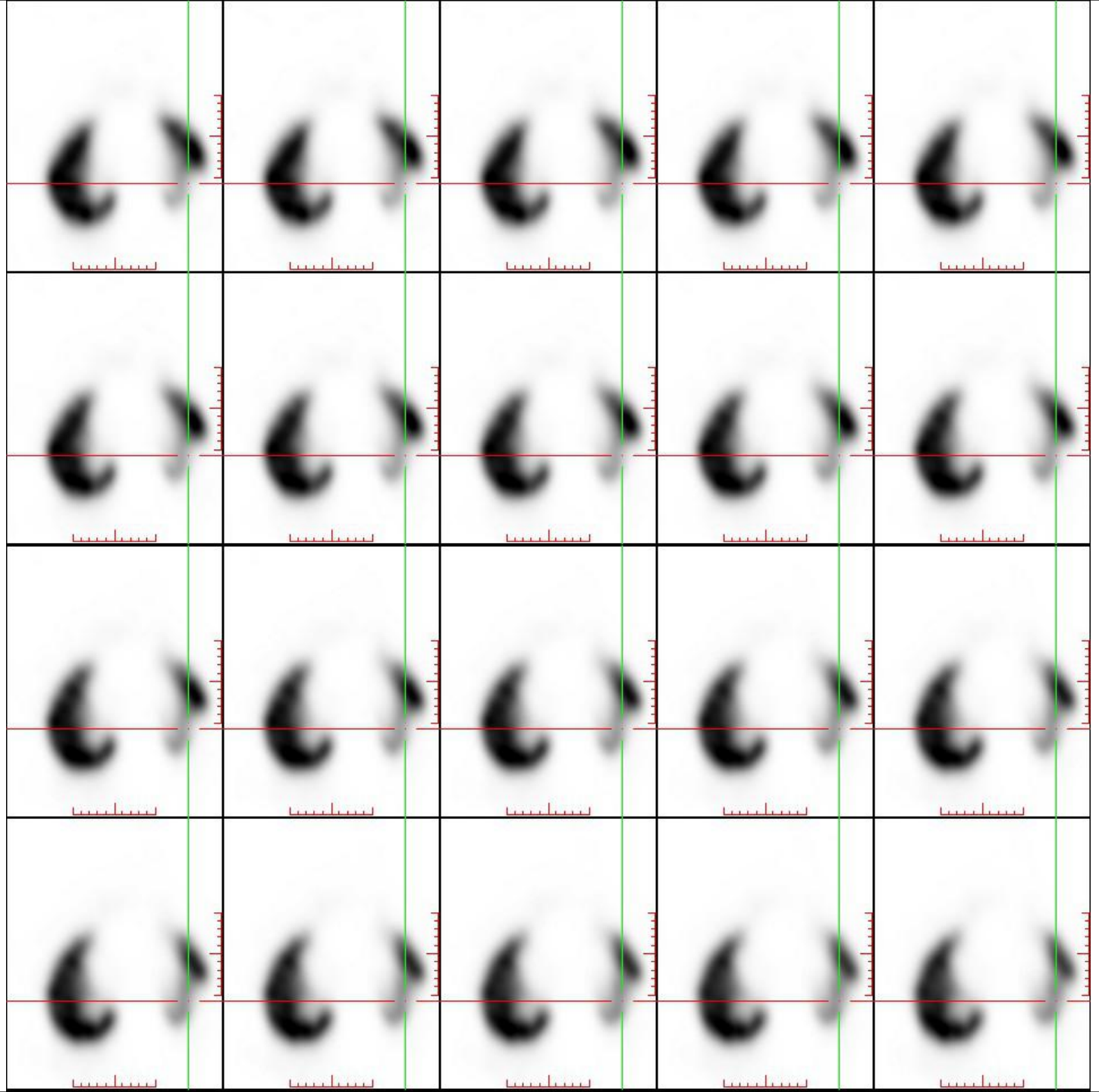
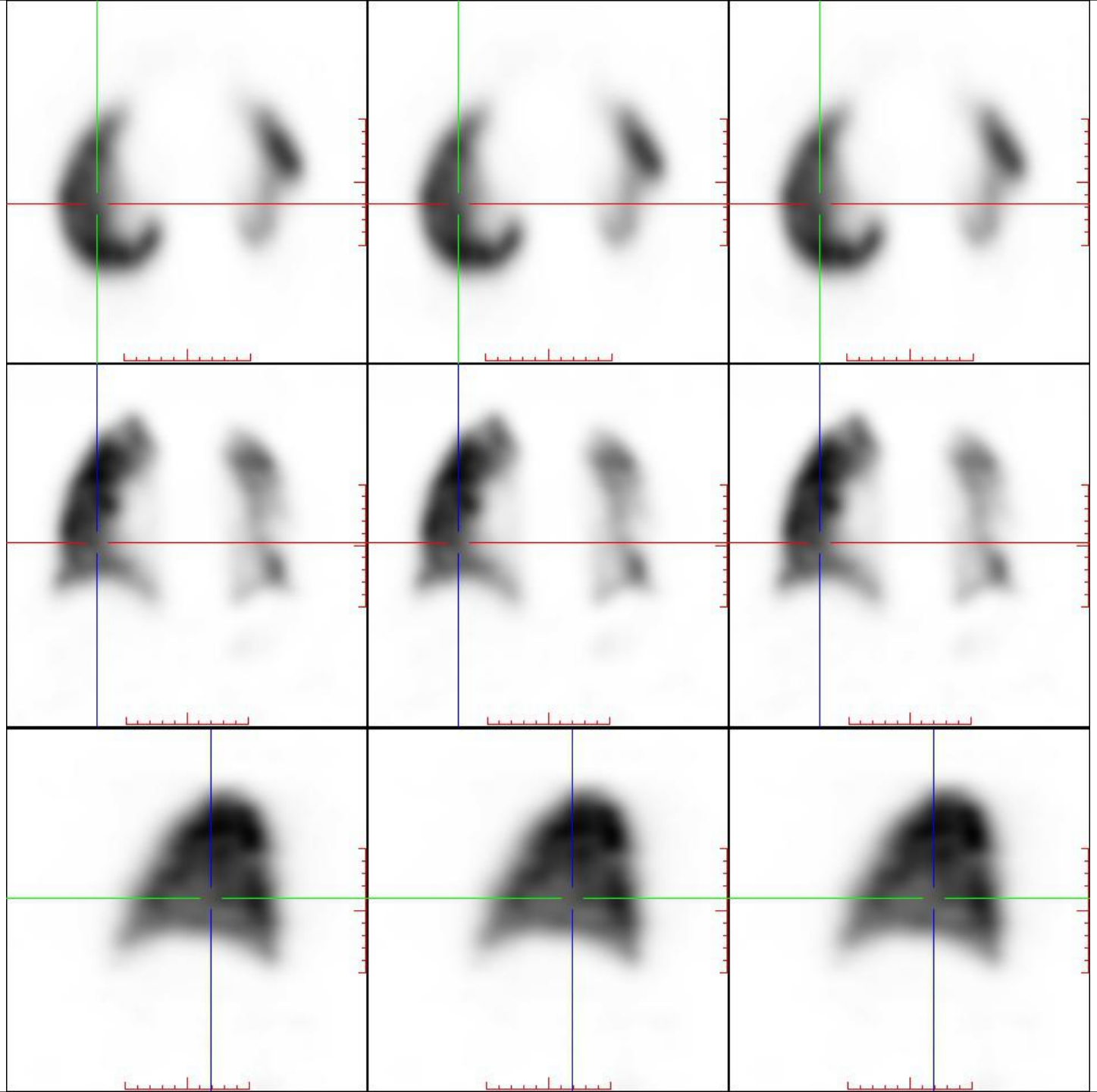


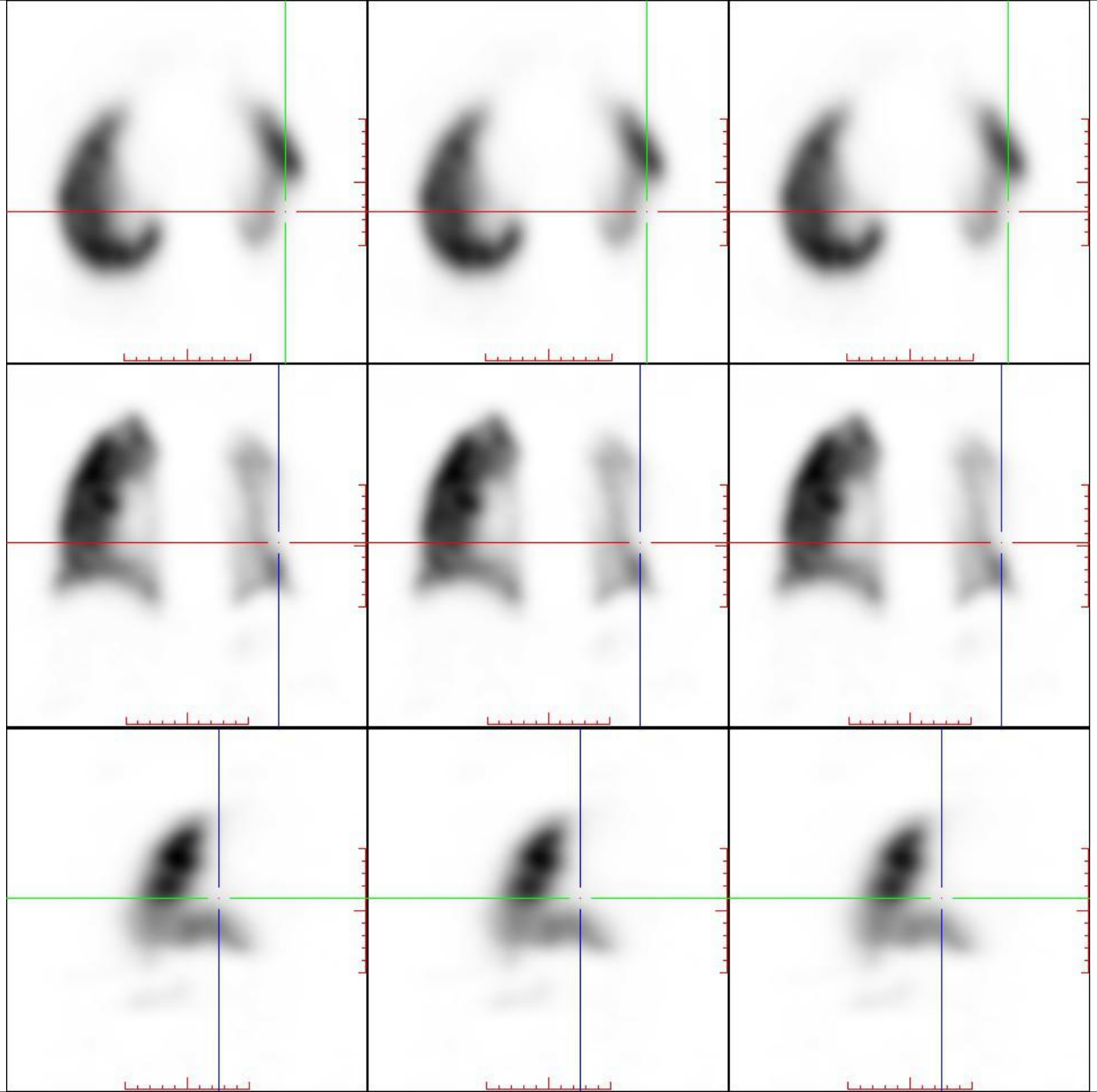
Post

All Images









检查所见：

静脉连续注射 99mTc-MAA 1mCi，5 分钟后行胸部 8 个体位显像，行胸部 8 个体位采集，结果如下:

肺血流灌注显像：双肺显影清晰，左肺下叶背段、后基底段放射性分布缺损，余双肺各段放射性分布较均匀。

肺灌注 SPECT 显像：示左肺下叶背段、后基底段放射性分布缺损。

检查意见：

双肺血流灌注显像示：左肺下叶背段、后基底段放射性分布缺损，首先考虑为肺栓塞，必要时进一步检查或治疗后复查。

结论

- ✓肺灌注-通气显像在孕妇是安全的
- ✓科室有相应的应急流程

为了使此事的流程更顺畅，我们提出如下的流程：

1. 正常工作日下班之后如有怀疑肺栓塞的孕妇，可以直接给杨吉刚主任打电话，核医学科确保这些患者在次日完成此检查，当日下班前将检查结果发给临床。

2. 周末如有怀疑肺栓塞的孕妇，可以直接和杨吉刚主任联系，核医学科将在上班第一天内完成肺通气显像和肺灌注显像，当日下班前将检查结果发给临床。

3. 假日（3 日小长假）如有怀疑肺栓塞的孕妇，处理原则同 2。

4. 假日（7 日小长假）如有怀疑肺栓塞的孕妇，和杨吉刚主任联系后，如果放射性药品的供应没有问题，我们将协助完成该检查。如果放射性药品的供应有问题，则在上班第一天内完成肺通气显像和肺灌注显像，当日下班前将检查结果发给临床。

【2018京医年味儿】除夕会诊、初一剖宫产手术，核医学科也跟着忙乎，77个春节宝宝降生北京友谊医院

2018-02-28 中国核医学医师

2月16日上午8点，这是北京友谊医院大年初一的第一台手术。在前一天晚上全院会诊的基础上，手术进行得很顺利。伴有子痫前期重度、肺栓塞、心功能不全等多种疾病的31岁高危孕产妇小安（化名）顺利产下一名男婴。虽然尚未足月、只有1550克重，却让所有人稍稍松了一口气。

2月14日腊月二十九晚上，怀孕31周的小安由于胸憋，不能平卧、伴全身水肿加重自外院转诊到北京友谊医院接受治疗。此前已有过3

中国移动 中国移动 下午4:50
中国核医学医师
微信号: BFH1952

2月14日腊月二十九晚上，怀孕31周的小安由于胸憋，不能平卧、伴全身水肿加重自外院转诊到北京友谊医院接受治疗。此前已有过3次胎停育经历的小安患有易栓症，目前检查诊断子痫前期重度，心功能不全、胸腔积液，低蛋白血症，高钾血症，右肾积水，抗磷脂抗体综合征。

2月15日腊月三十下午，为了尽快明确诊断，核医学科主任杨吉刚专程从家赶往医院，为小安进行肺灌注显像检查，结果显示大面积肺栓塞！此时的小安随时可能发生病情加重，出现心衰、心律失常、肺水肿、循环功能紊乱、颅内出血等情况，甚至会有猝死的风险，也腹中的胎儿也有可能因为子痫、胎盘早剥等原因随时发生胎儿窘迫、胎死宫内的危险。

Case

- 女，58岁，主因“腰椎管狭窄”于骨科 住院治疗
- 给予追弓根钉内固定术，术后恢复可，护具协助下可下床活动
- 术后5天坐位说话时，突然出现意识丧失，约2分钟后恢复
- 意识恢复后感乏力，活动后心悸、多汗
- 血压、心电图、心肌酶、血糖正常
- 血氧低 PO2 62mmHg （80-108）
- D-D 2.3mg/L（0-1.5）

胸CTA

检查名称：

胸部 平扫+增强

检查技术：

扫描范围：肺尖-肺底；常规扫描参数：层厚5mm、层间隔5mm

检查所见：

胸廓两侧对称，支气管血管束清晰。左肺尖小结节样磨玻璃密度影（im9），边界稍模糊，直径约0.4cm；右肺上叶后段、左肺下叶背段、双肺下叶基底段斑片磨玻璃密度及索条影、网格影。主气管、双肺支气管及其分支管腔通畅。双侧肺门及纵隔内未见明显增大淋巴结。心脏形态、大小如常。未见明确胸膜病变。胸廓骨质及软组织结构无明显异常。

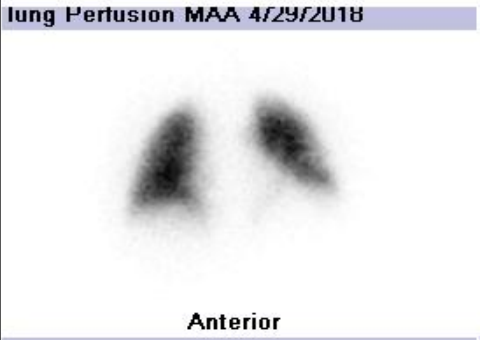
肺动脉主干及其各级分支造影剂充盈良好，未见充盈缺损。

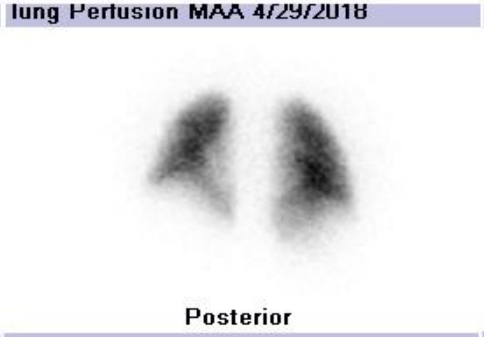
检查诊断：

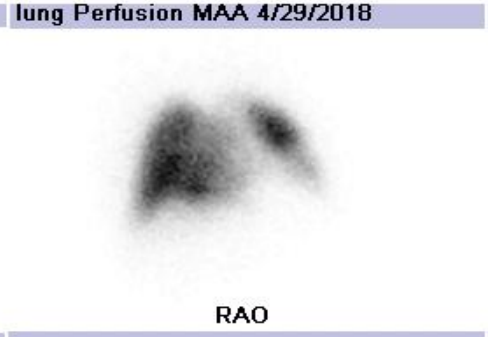
1、左肺尖磨玻璃密度小结节，请结合临床3个月后复查；

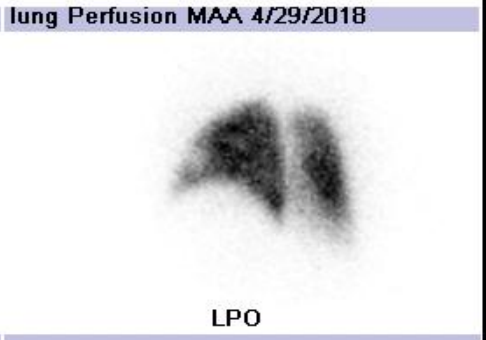
2、双肺磨玻璃密度，间质性病变可能，请结合临床并复查。

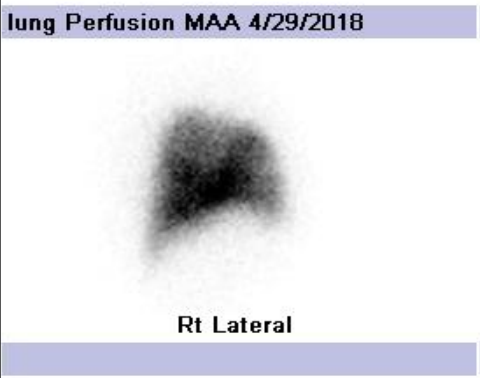
Patient Name: LIU SHU RONG
Patient ID: 03581327
Sex: F
Study Name: Lung Perfusion Scan
Age: 058Y
Study Date: 4/29/2018

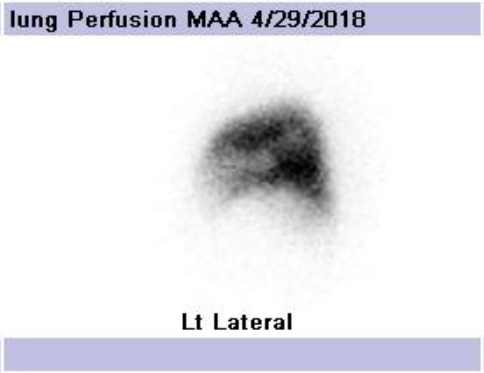


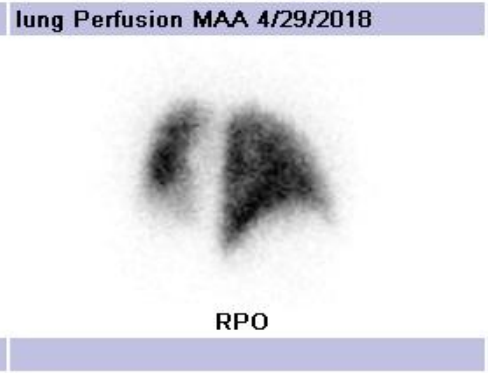


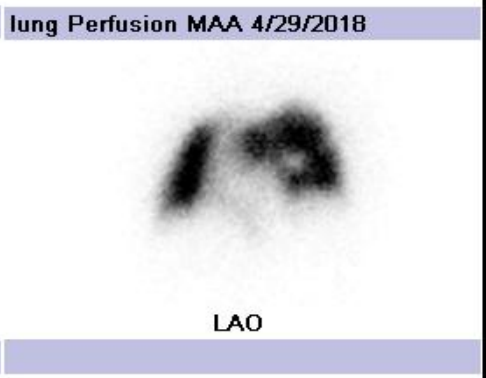




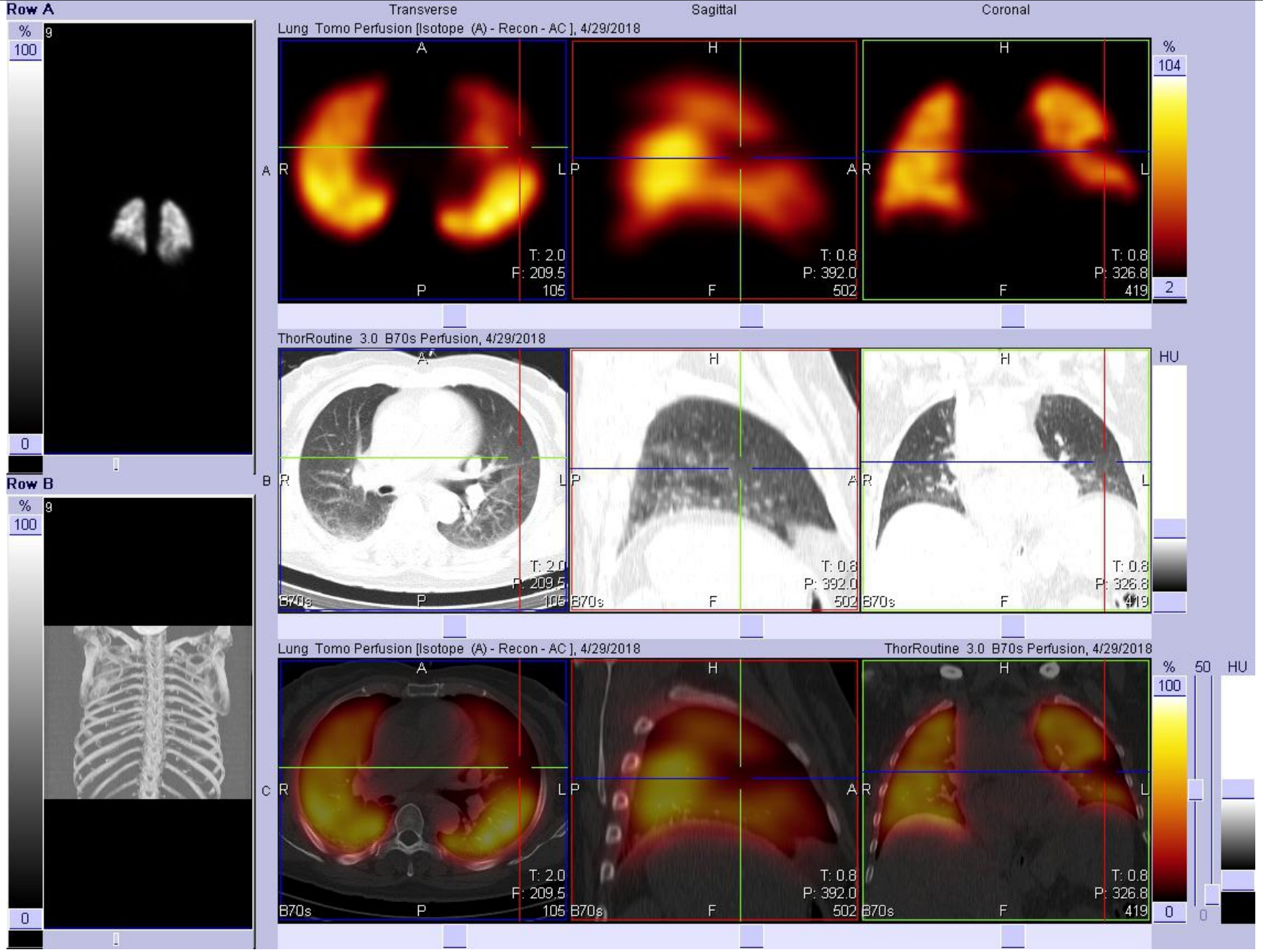




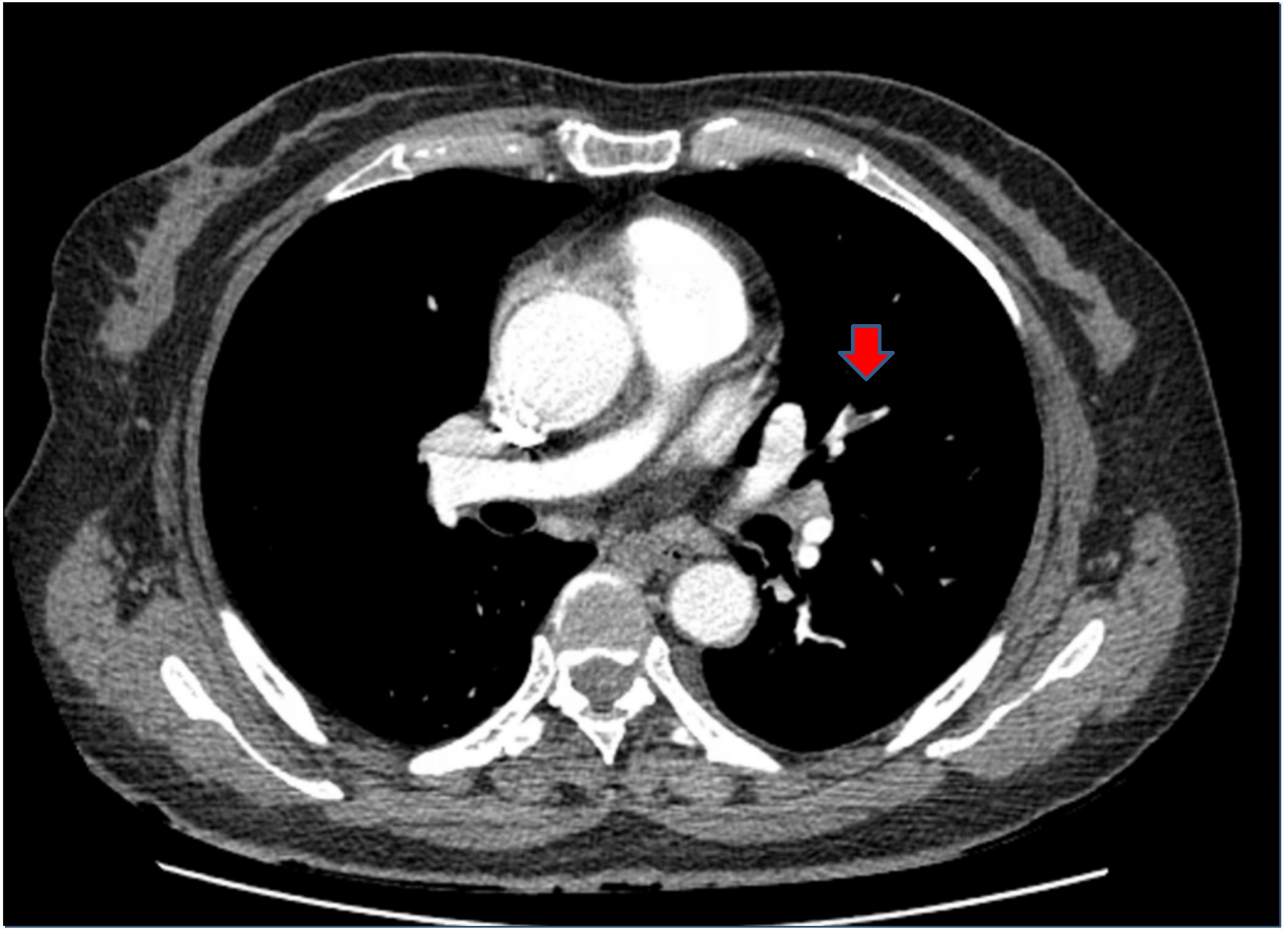


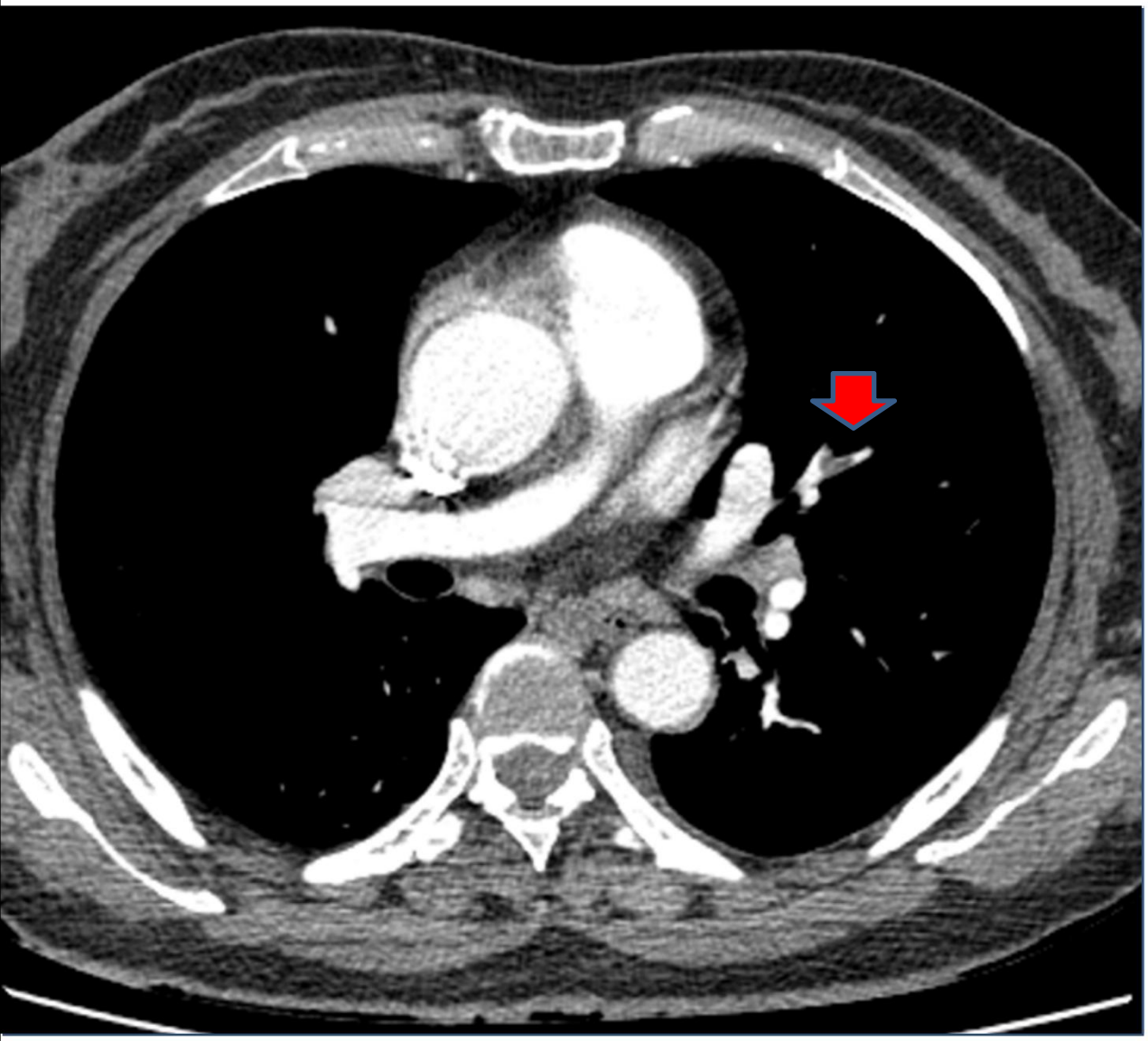


左肺上叶舌段 —— 放射性缺损

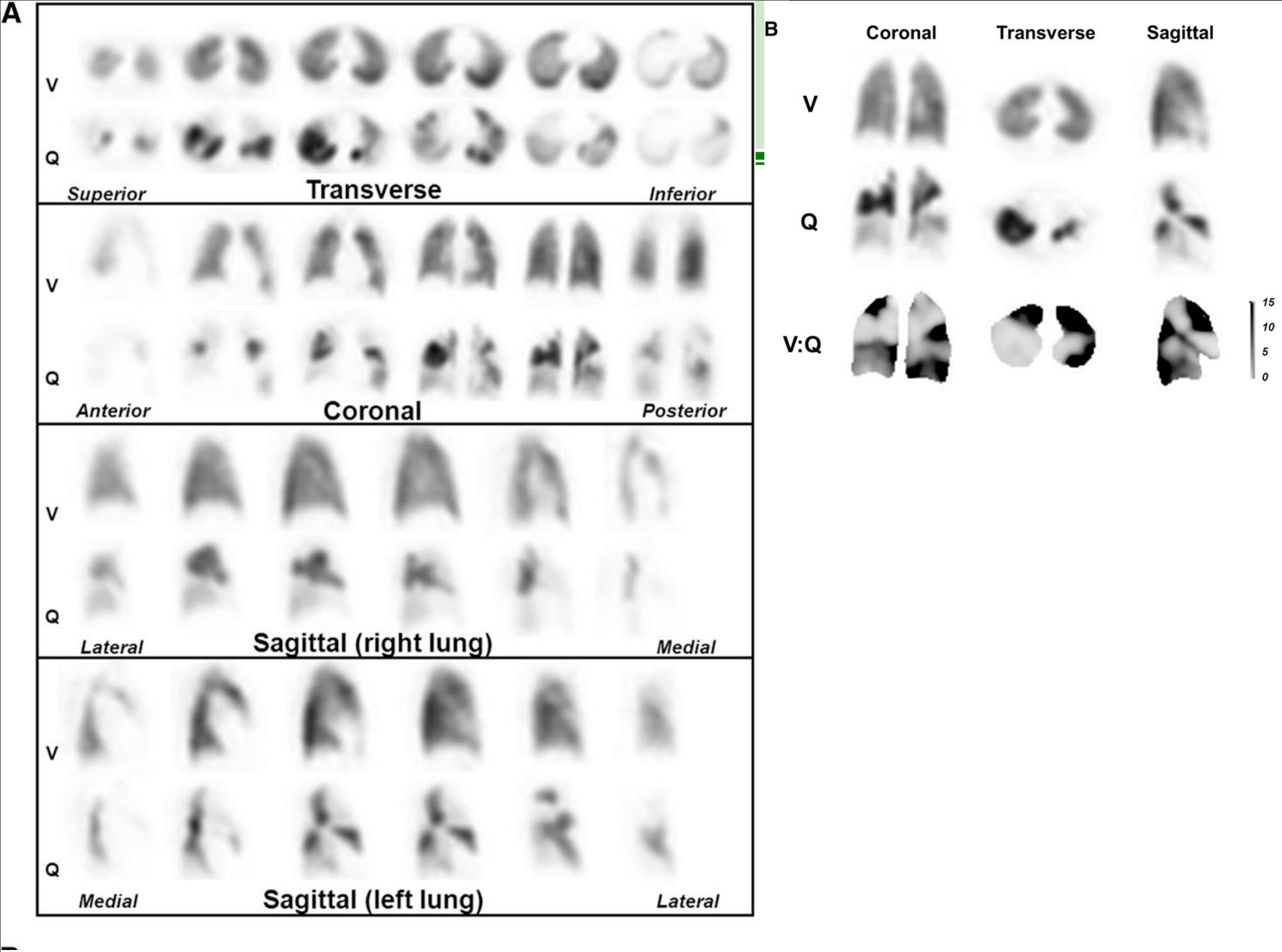

Row A
Transverse
Sagittal
Coronal
Lung Tomo Perfusion [Isotope (A) - Recon - AC], 4/29/2018
ThorRoutine 3.0 B70s Perfusion, 4/29/2018
Row B
Lung Tomo Perfusion [Isotope (A) - Recon - AC], 4/29/2018
ThorRoutine 3.0 B70s Perfusion, 4/29/2018
%
100
0
104
2
HU
50
A
B
C
R
L
P
H
F
T: 2.0
F: 209.5
105
T: 0.8
P: 392.0
502
T: 0.8
P: 326.8
419
B70s

左肺上叶舌段






A
R
L
P
T: 2.0
F: 209.5
105
ThorRoutine 3.0 B70s Perfusion, 4/29/2018
A
R
L
P
T: 2.0
F: 209.5
105
B70s


A
V
Q
Superior
Transverse
Inferior
V
Q
Anterior
Coronal
Posterior
V
Q
Lateral
Sagittal (right lung)
Medial
V
Q
Medial
Sagittal (left lung)
Lateral
B
Coronal
Transverse
Sagittal
V
Q
V:Q
15
10
5
0

V/Q诊断PE分类

- 高度可能性
- 中度可能性
- 低度可能性
- 肺血流灌注显像正常

高度可能性

- ≥2个肺段灌注缺损
- 通气正常
- 胸片正常或支持PE的异常

诊断率>90%(96-98%)

中度可能性

- ≤1肺段或2-3亚段灌注缺损
- 通气部分填充或正常
- 胸片正常

诊断率50-75%。

低度可能性

- 肺叶，肺段，多个亚段Q/V匹配
- 胸片正常

诊断正确率<25%，可排除PE

肺血流灌注显像正常

- 排除PE

肺显像的评价

- 肺栓塞长期以来肺动脉造影为金标准
- 肺Q/V诊断PTE的灵敏度和特异性均在90%
- 临床可疑肺栓塞患者，15%可用显像诊断，65%可排除，20%属较大可能性

Radiation dose

- ✓ The major concern with young women breast
- ✓ breast exposure from CTPA from **20to 60 mSv**
- ✓ In fact,a study reported dose delivery to the breast as high as **50-80 mSv**
- ✓ In comparison, a full V/Q scan delivers **0.28-0.9 mSv to the breast**

Semin Nucl Med. 2013 Mar;43(2):82-7.

Radiation dose

- ✓ Although exposure to the fetus is comparable with CTPA, exposure to the breast is still a concern.
- ✓ V/Qscans should be the initial modality for the evaluation of PE in pregnant patients presenting to the ED
- ✓ **Low-dose ung scans (37 MBq Tc-99m MAA) on pregnant patients further decrease the radiation**

Semin Nucl Med. 2013 Mar;43(2):82-7.

Result

- ✓ In 2006, 1979 imaging studies were performed for PE of which 1234 were CTPAs and 745 were V/Qs.
- ✓ In 2007, following the new algorithm, 2136 exams were performed of which 920 were CTPAs and 1216 were V/Q exams.

- ✓ Semin Nucl Med. 2013 Mar;43(2):82-7.

Small PE—Should TheyBe Treated?

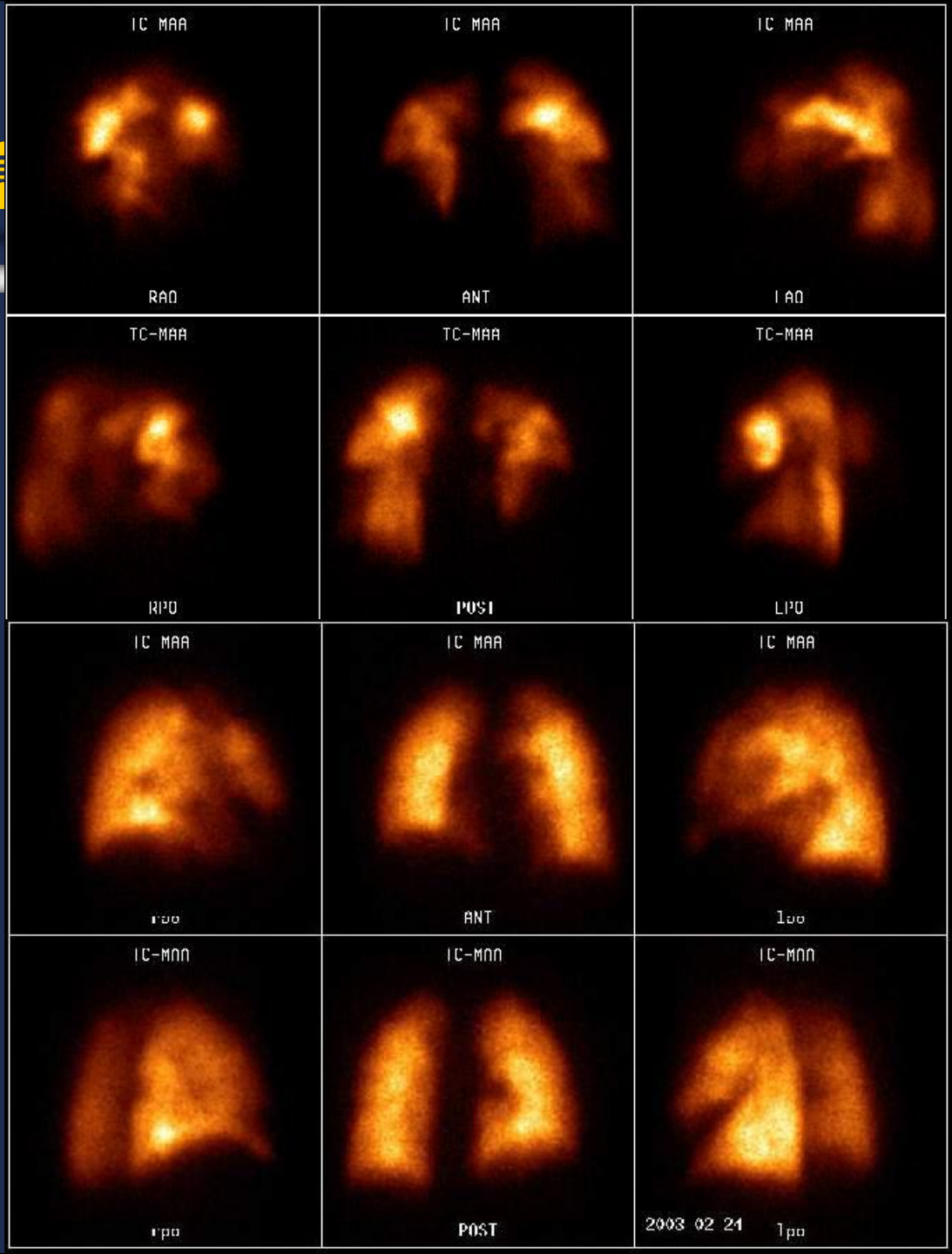
- ✓ **More PE** are detected on CTPA compared with V/Q
- ✓ All of the additional PE detected on the CTPA **did not necessarily** require treatment
- ✓ Despite the doubling of PE diagnosis, the death rate was **unchanged**. Therefore, the additional PEs discovered with CTPA were clinically **irrelevant**.
- ✓ **Pulmonary arteries and capillary contains an intrinsic fibrinolytic system. Lower extremity veins do not possess this fibrinolytic activity**

- ✓ Semin Nucl Med. 2013 Mar;43(2):82-7.

肺栓塞

肺栓塞治疗前

肺栓塞治疗5天后



2018-7-31

肺栓塞诊断与辅助检查关系

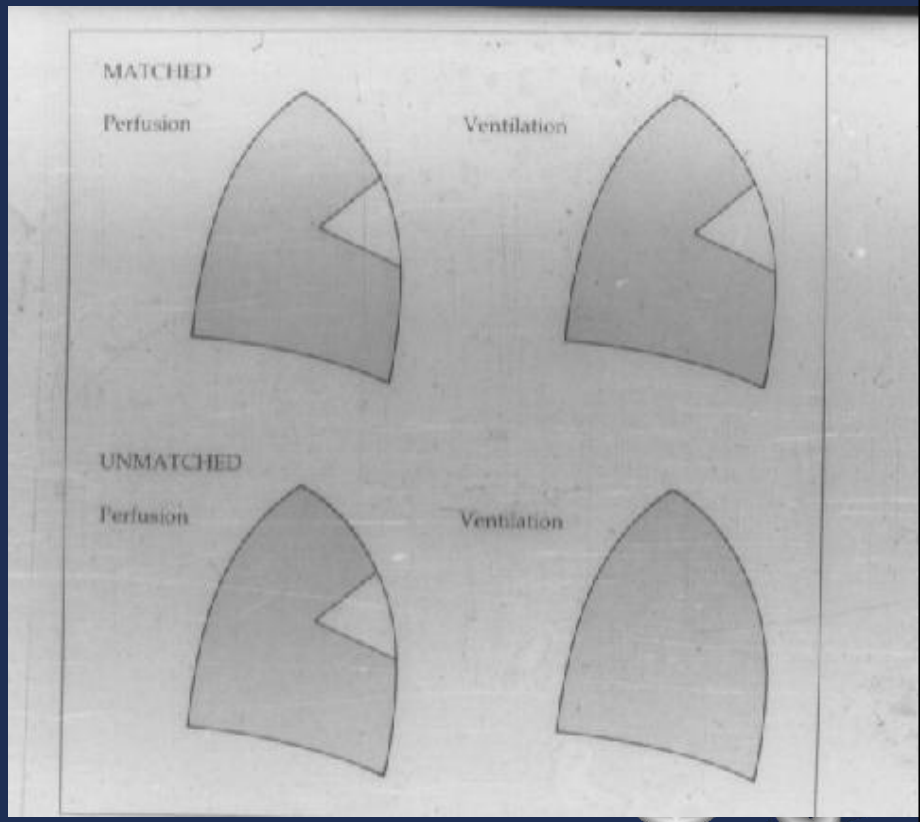
肺栓塞与COPD的对比示意图

- COPD灌注缺损
- COPD通气也缺损

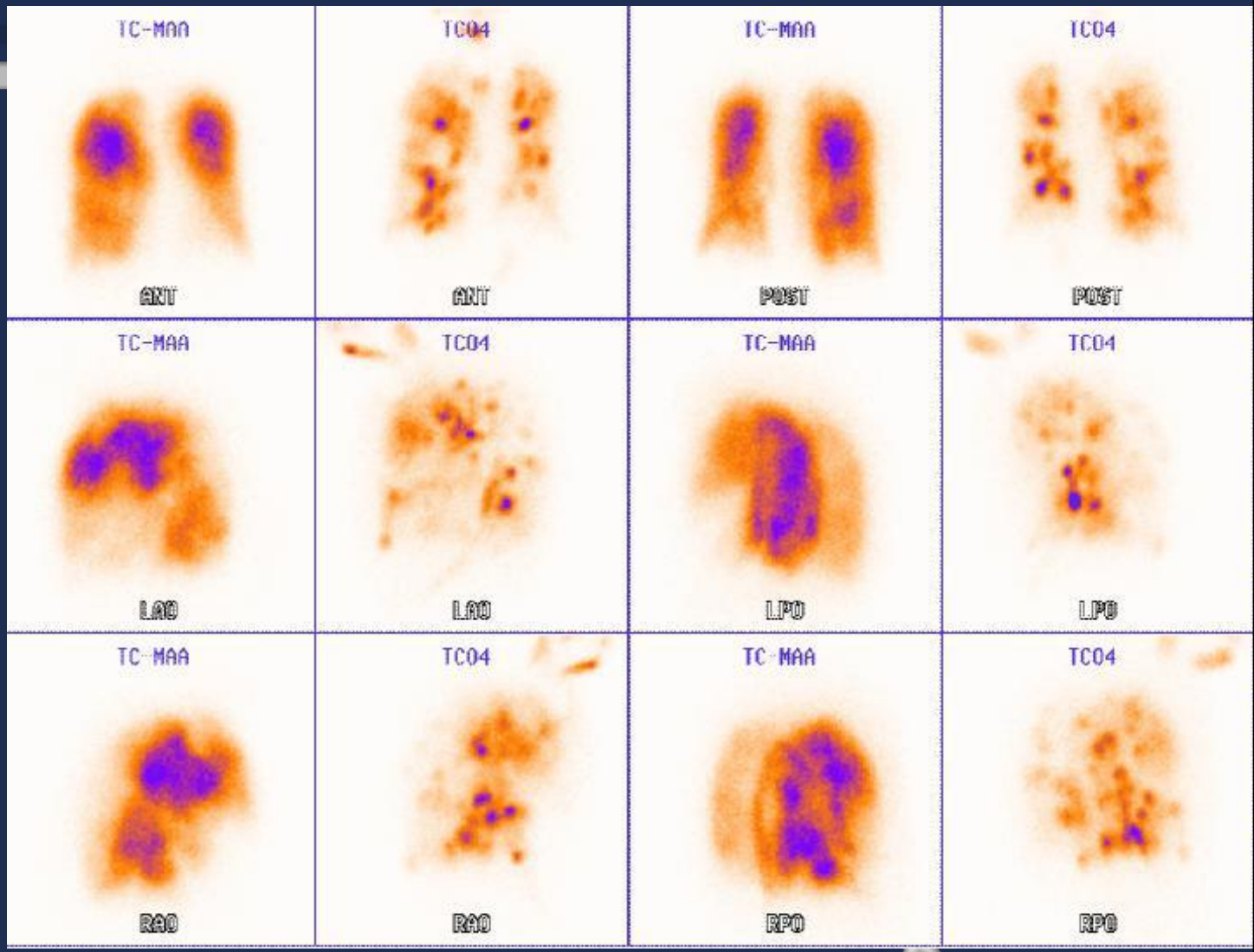
匹配

- 肺栓塞灌注缺损
- 肺栓塞通气不缺损

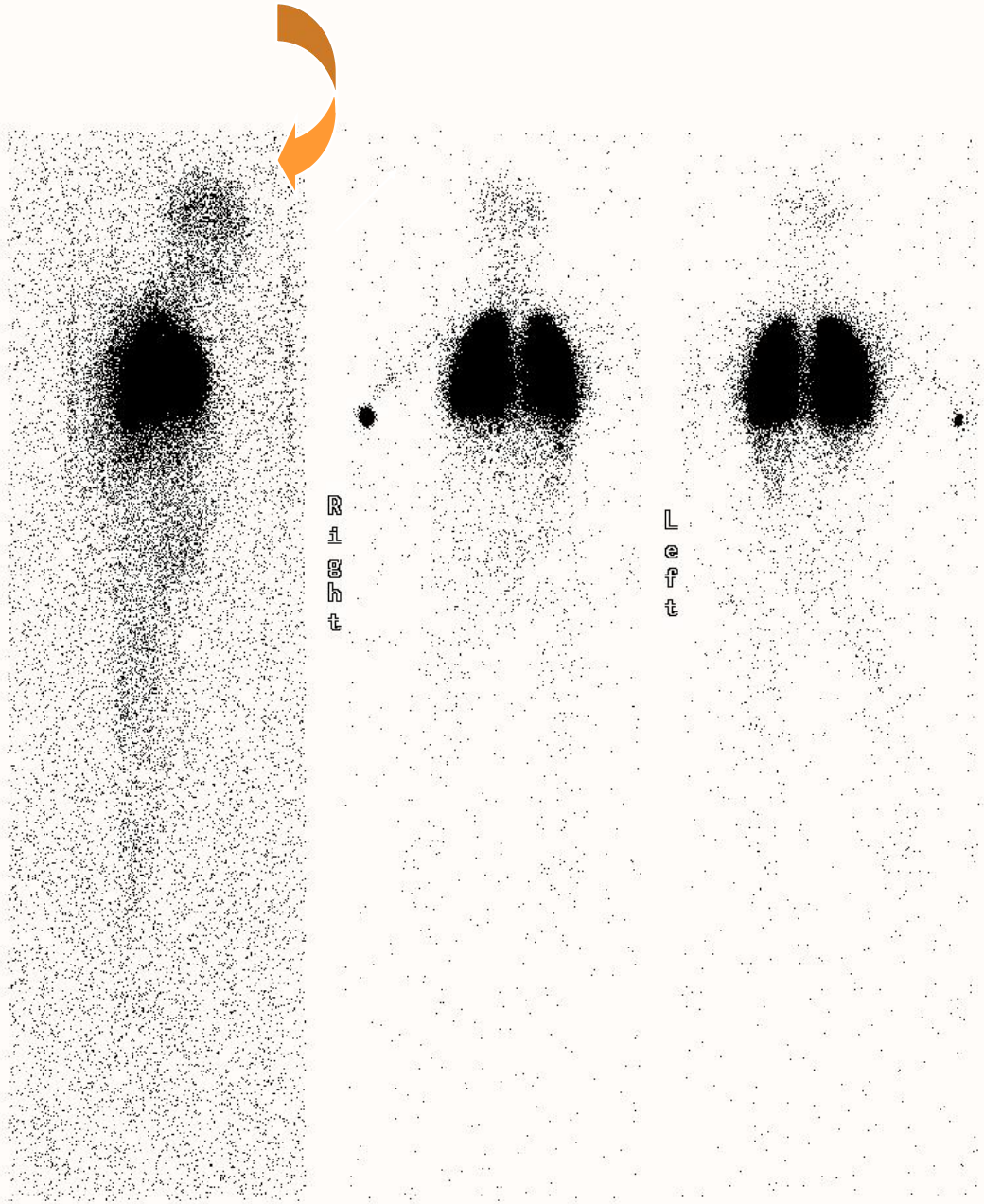
不匹配

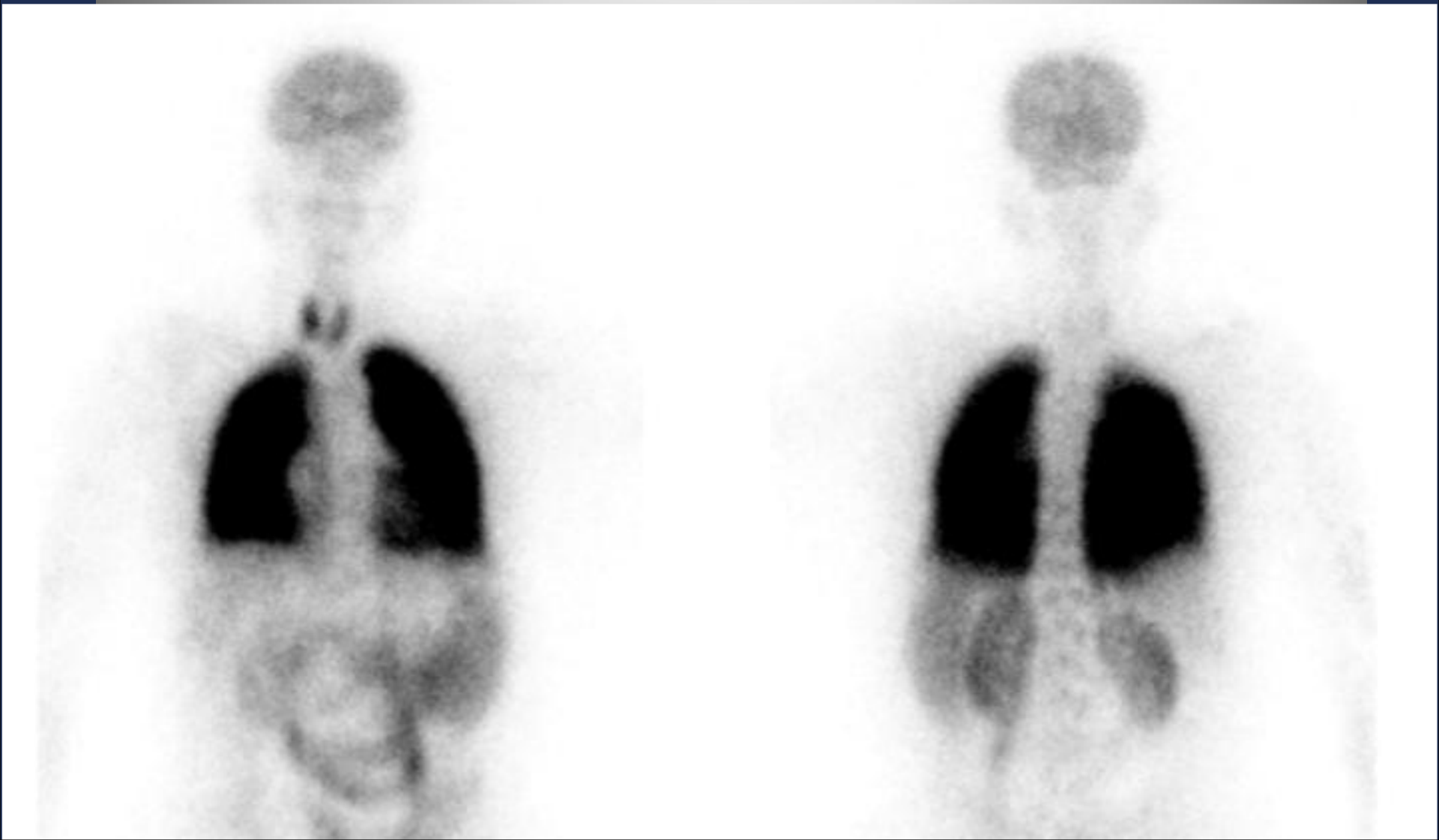


- 肺灌注显像
- 肺通气显像
- 典型COPD

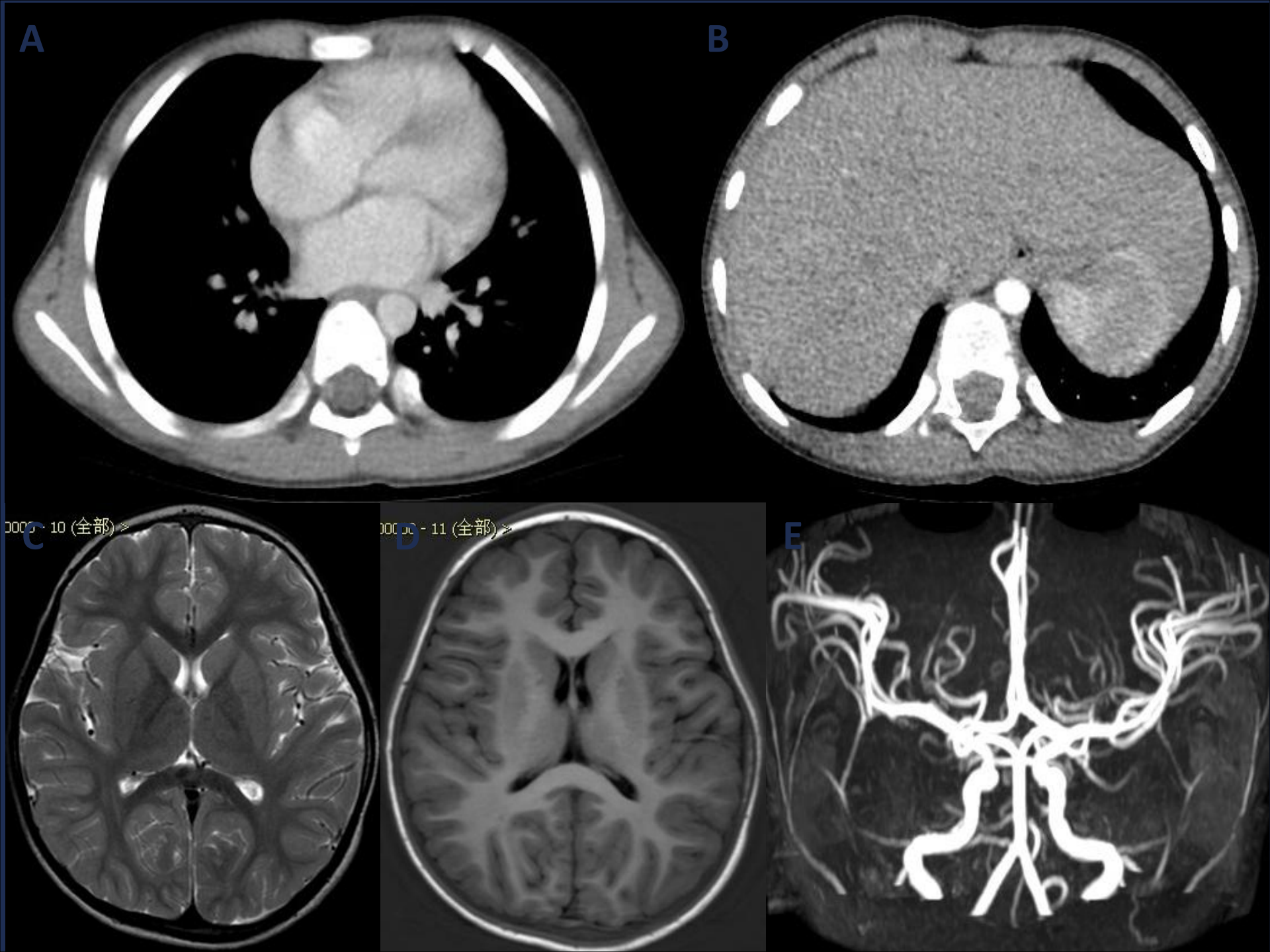


肝硬化、肺内分流





Yang F, Yuan L, Ma D, **Yang** J. 99mTc-MAA Pulmonary Scintigraphy in Hereditary Hemorrhagic Telangiectasia.Clin Nucl Med. 2016 Aug;41(8):671-3.


A
B
C
D
E
- 10 (全部) >
- 11 (全部) >

下肢深静脉显像

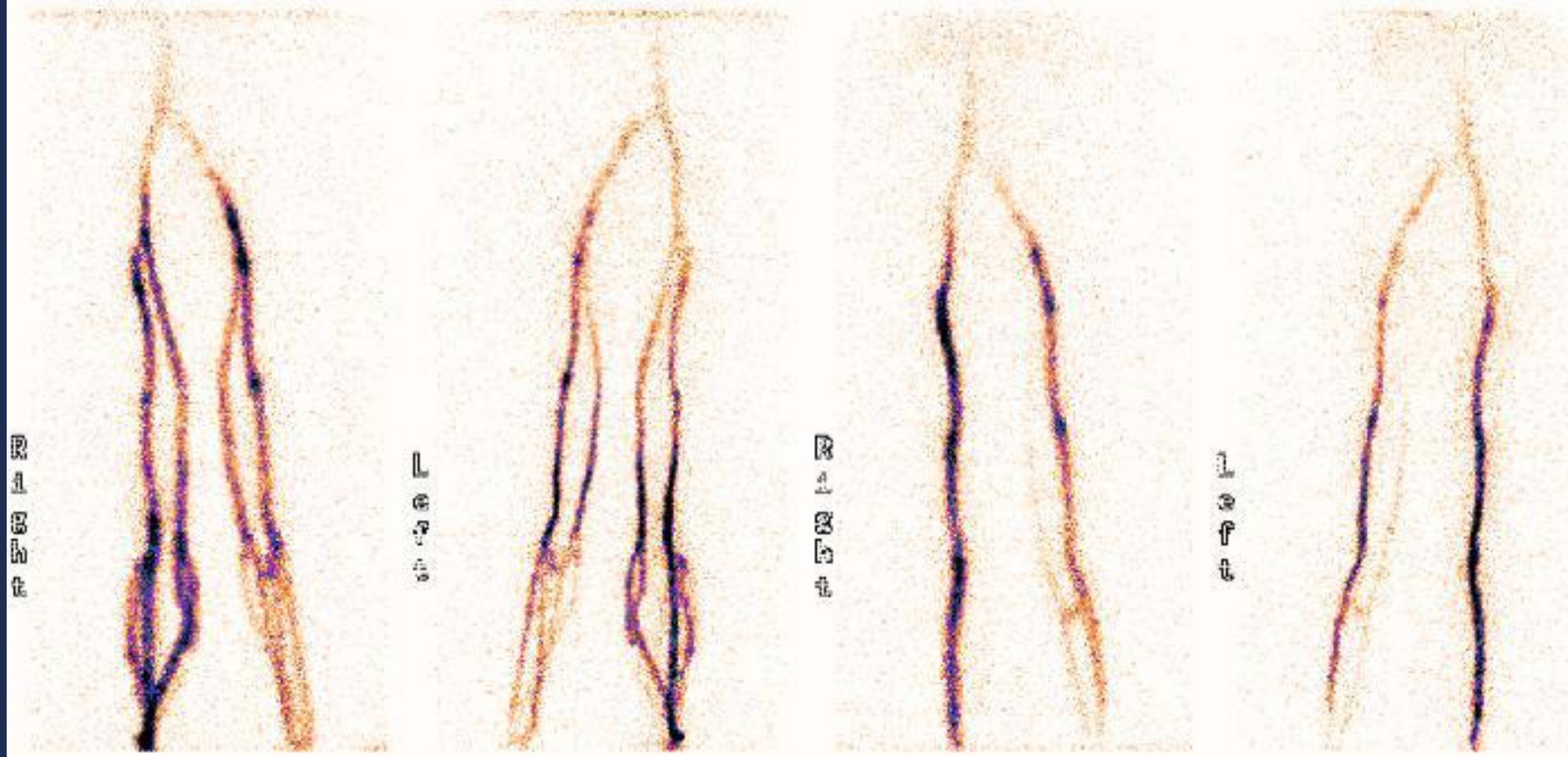
原理：

- 显像剂（99mTc-MAA）由足背浅静脉连续缓慢注入，使下肢静脉显像；
- 辅以止血带加压方法，可阻断浅静脉回流以单独显示深静脉影像；
- 下肢静脉显像可以与肺血流灌注显像同时进行。

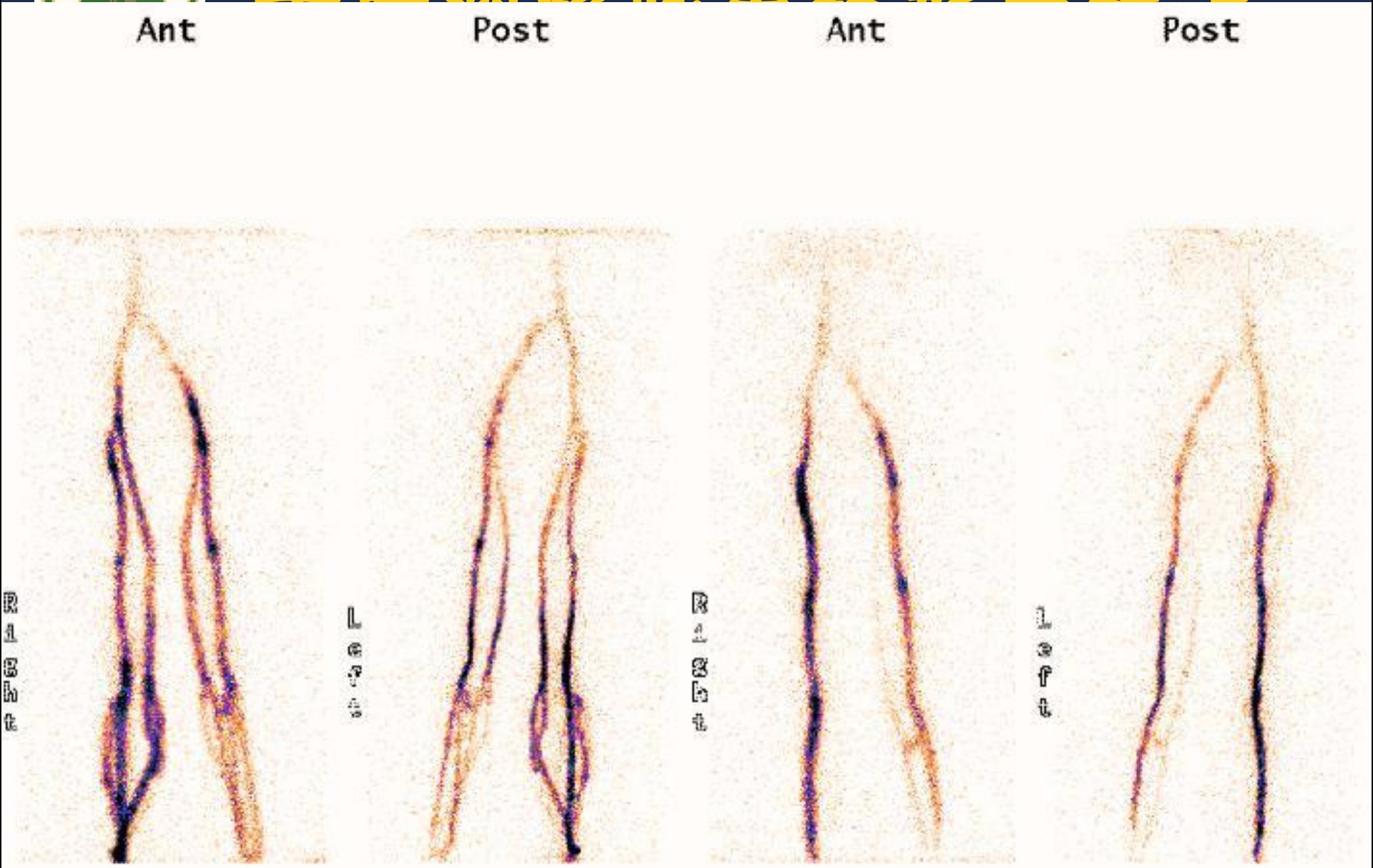
Ant Post Ant Post

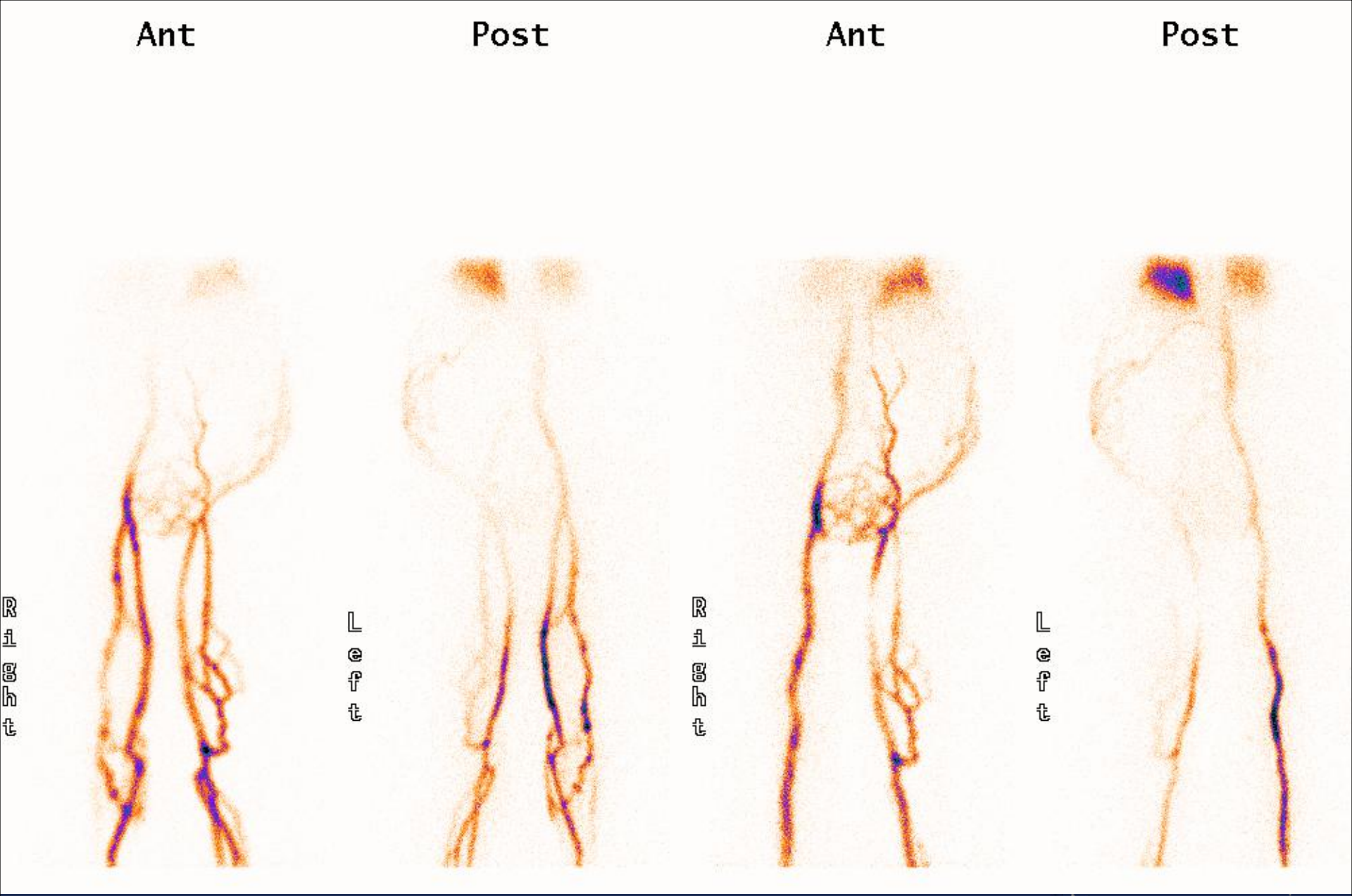
正常

隐静脉裂孔有5属支

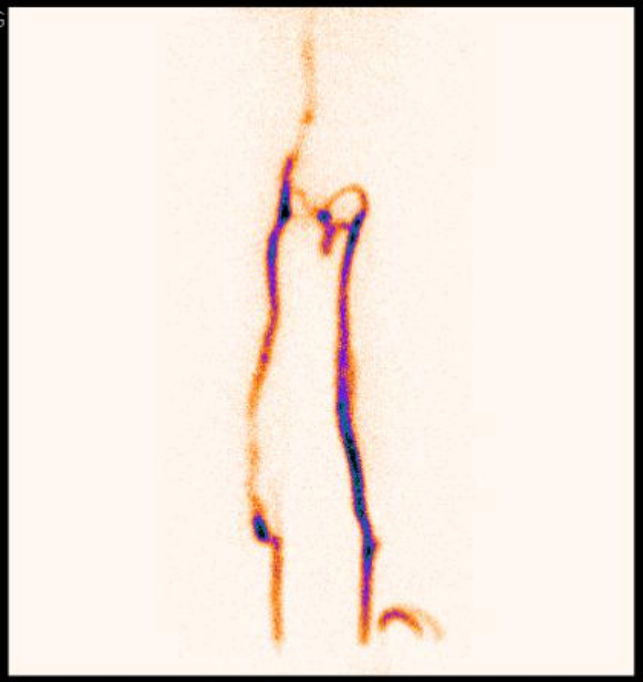


下肢深静脉血栓形成特点




Ant
Post
Ant
Post
Right
Left
Right
Left

ANTERIOR
ZHANG SHU GANG
02721387



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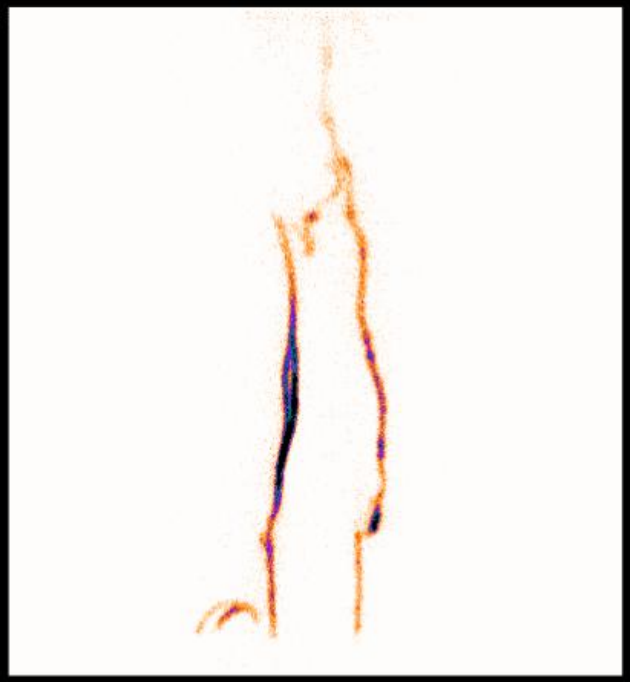
11/20/2009
ANTERIOR
Total Body

1 / 1

POSTERIOR
ZHANG SHU GANG
02721387



Width: 70 Level: 36

11/20/200
POSTERIO
Total Bo

1 /

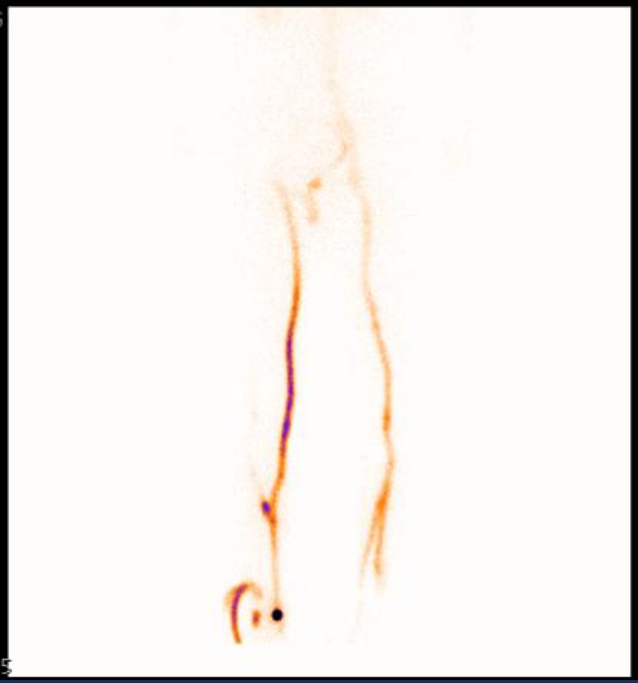
ANTERIOR
ZHANG SHU GANG
02721387

Width: 771 Level: 386

11/20/2009
ANTERIOR
Total Body

1 / 1

POSTERIOR
ZHANG SHU GANG
02721387



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11/20/200
POSTERIO
Total Bo

1 /

PET/CT

PET是什么？

P	Positron	正电子
E	Emission	发射
T	Tomography	断层显像

PET/CT显像的本质

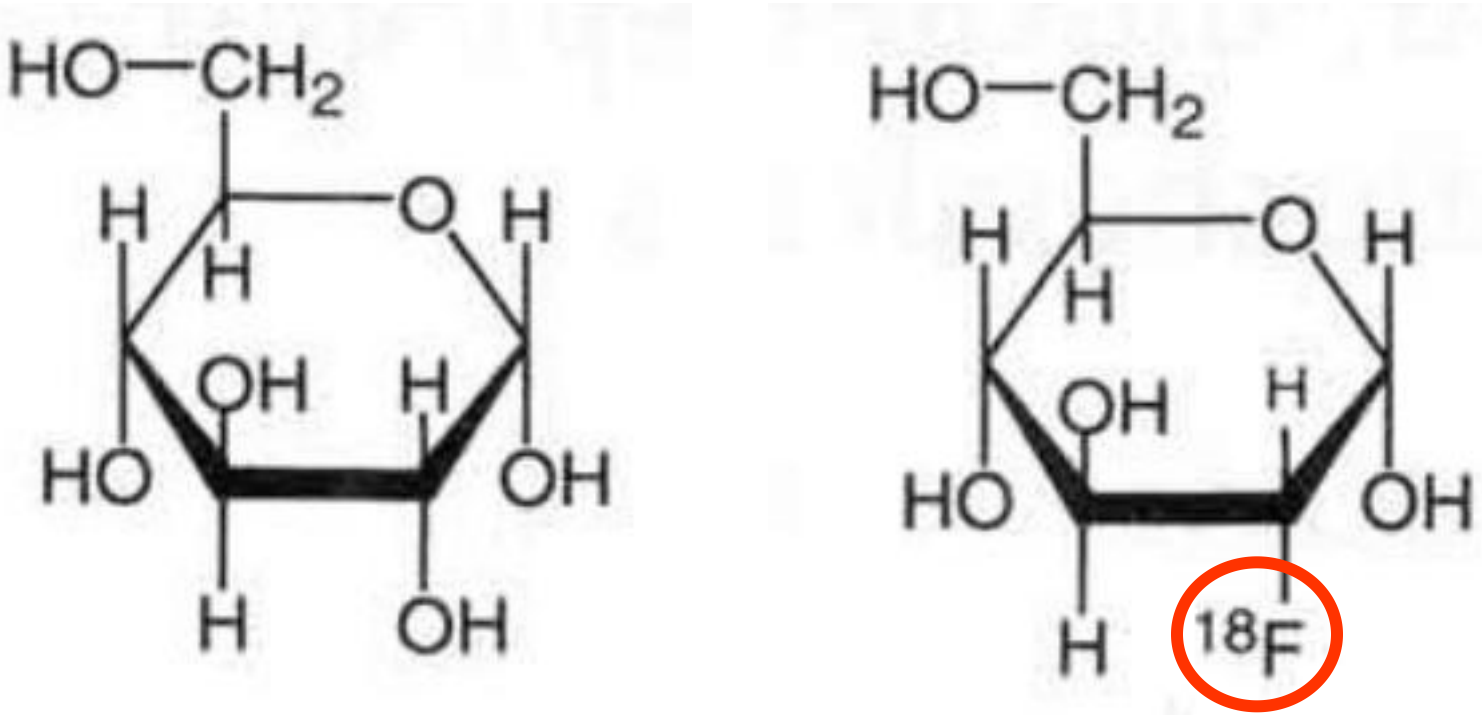
- ✓ 是一种“功能”显像。显示各脏器及病变组织对显像剂的摄取情况；
- ✓ 针对于肿瘤来说，它是“阳性”影像（即病灶出现显像剂明显浓聚，而正常组织不浓聚）；
- ✓ PET/CT从“生化角度”上研究疾病。

最常用显像剂——^{18}F-FDG

^{18}F-fluoro-2-deoxyglucose

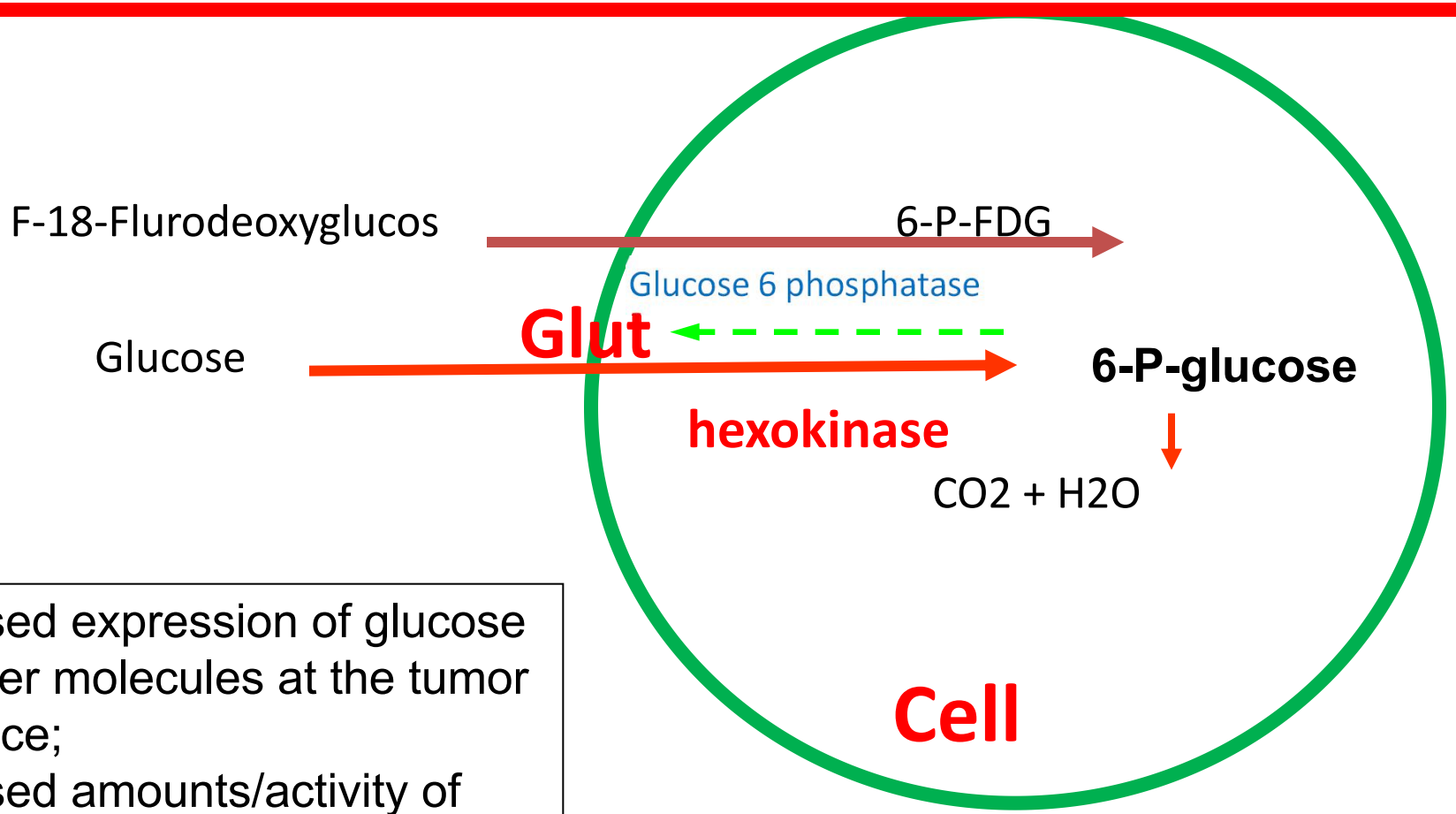
(^{18}F-脱氧葡萄糖）

^{18}F-FDG: Century Molecule



葡萄糖和^{18}F-FDG的分子结构比较

Mechanism of ^{18}F-FDG Uptake in tumor



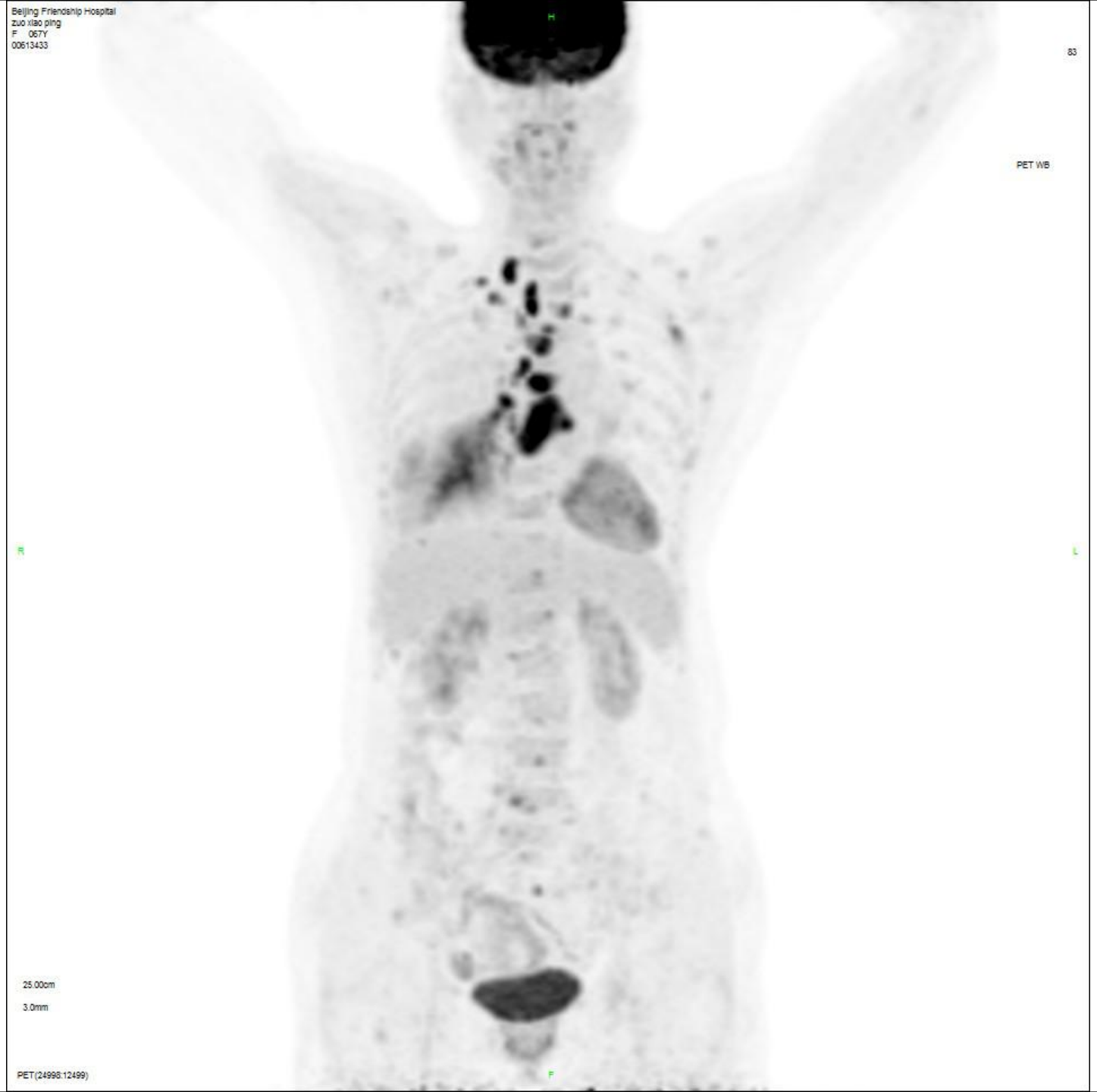
1.Increased expression of glucose transporter molecules at the tumor cell surface;
2.Increased amounts/activity of hexokinase;
3.Reduced amounts of glucose 6 Phosphatase versus most normal tissues.

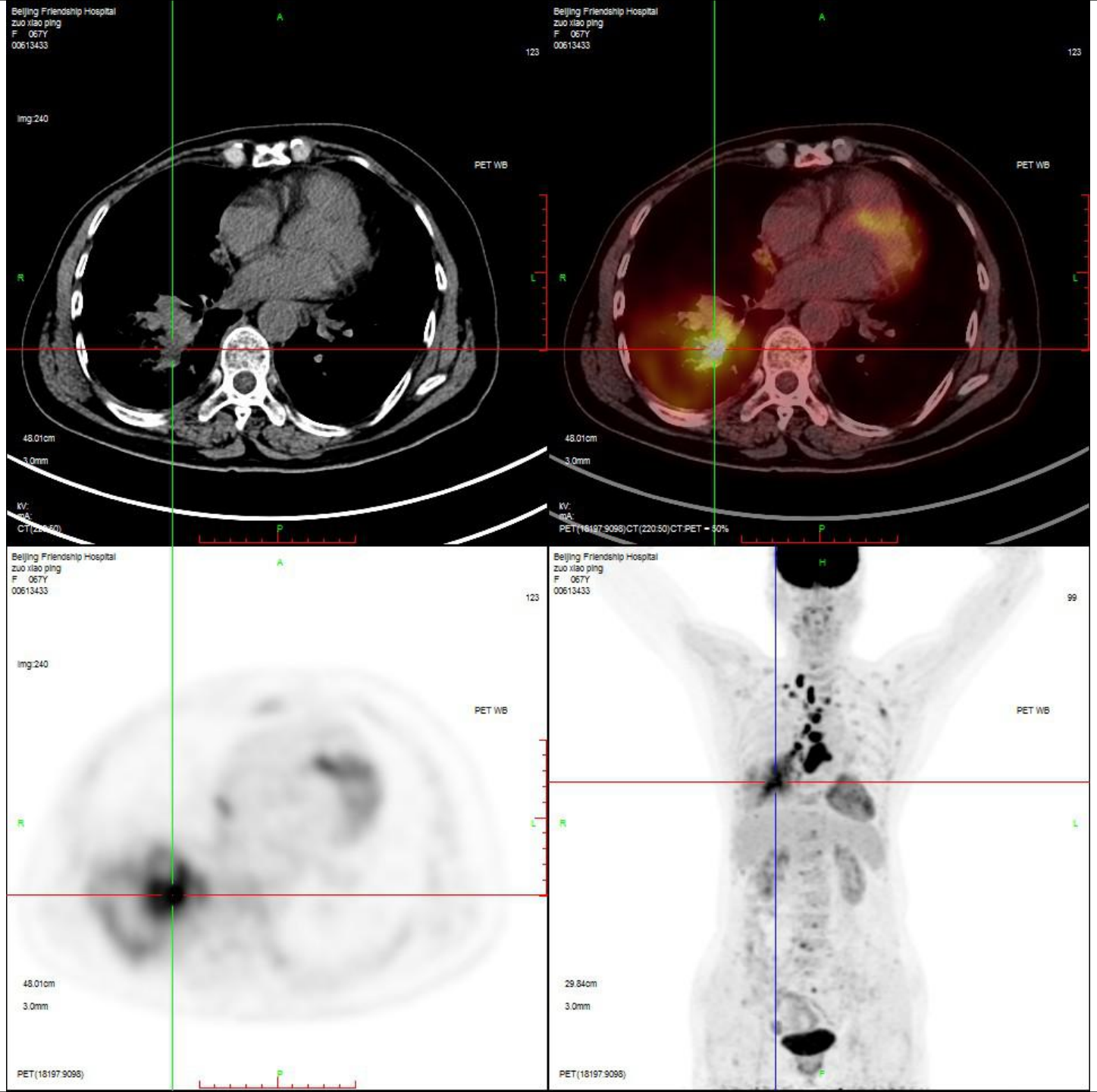
^{18}F-FDG PET-CT的临床应用

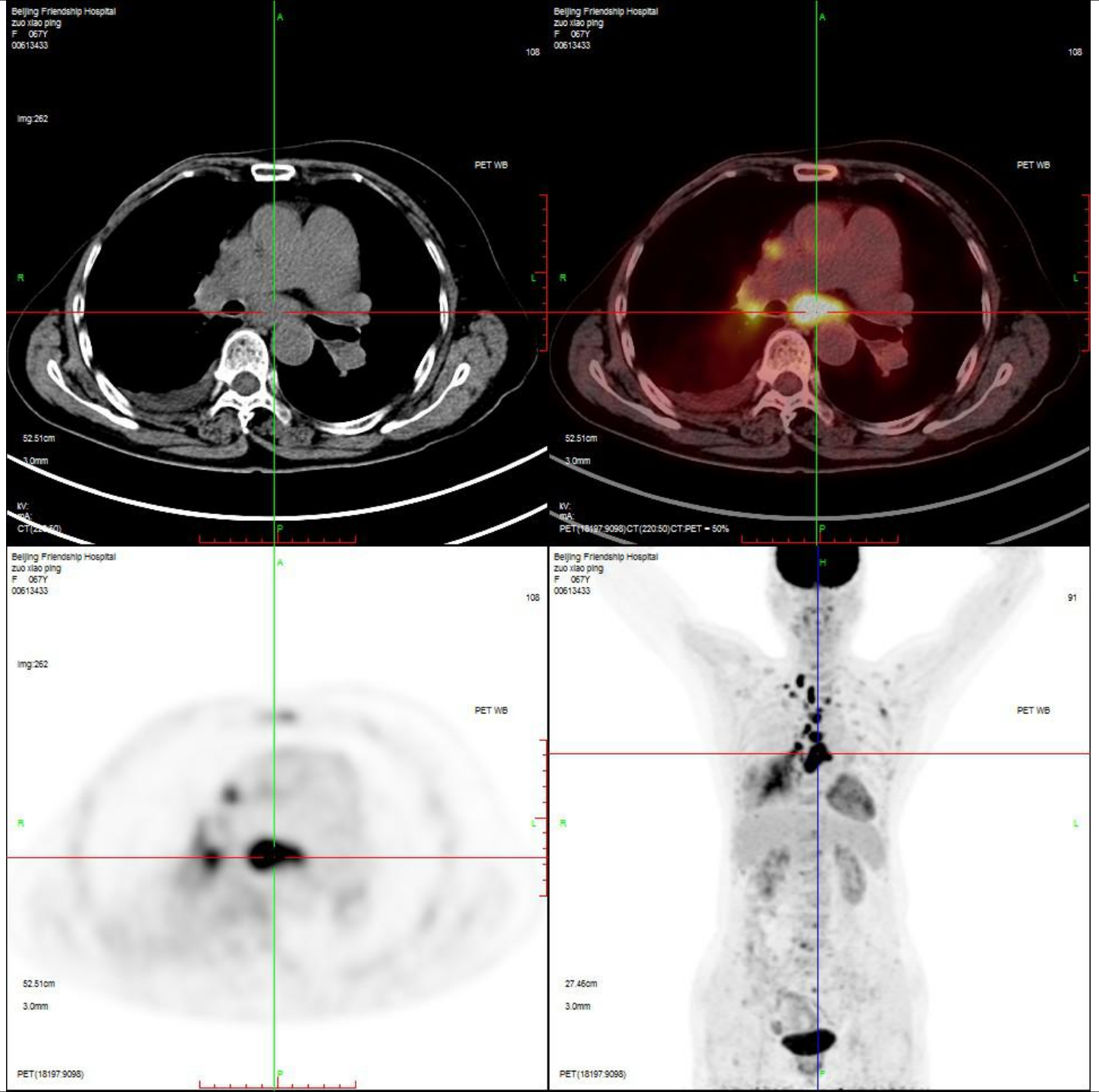
- ✓恶性肿瘤的诊断及良恶性鉴别
- ✓恶性肿瘤的分期
- ✓恶性肿瘤的疗效评价
- **✓恶性肿瘤的预后评估，SUVmax→TLG、MTV**
- ✓其他，如FUO、HLH……

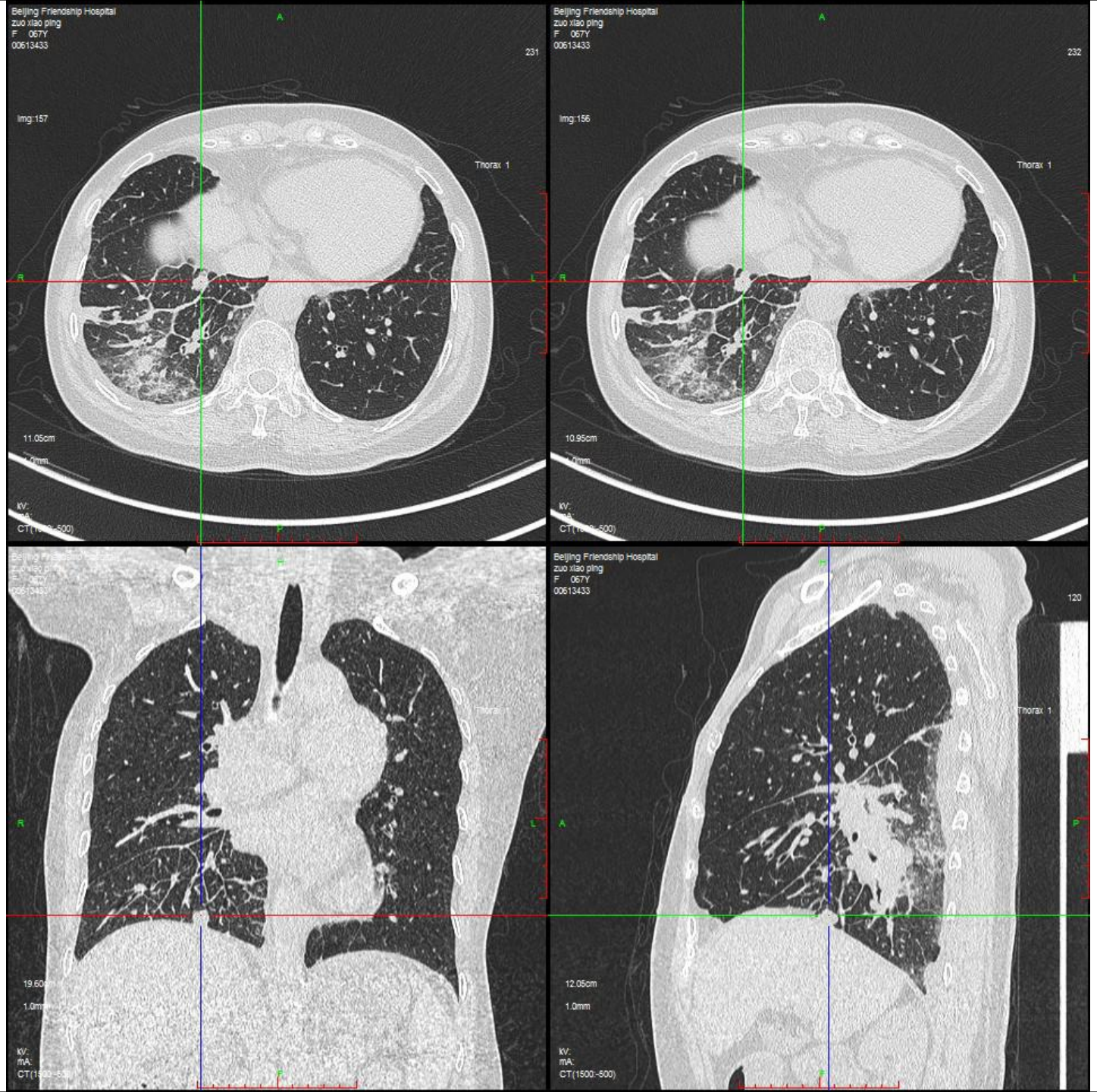
呼吸内科病例

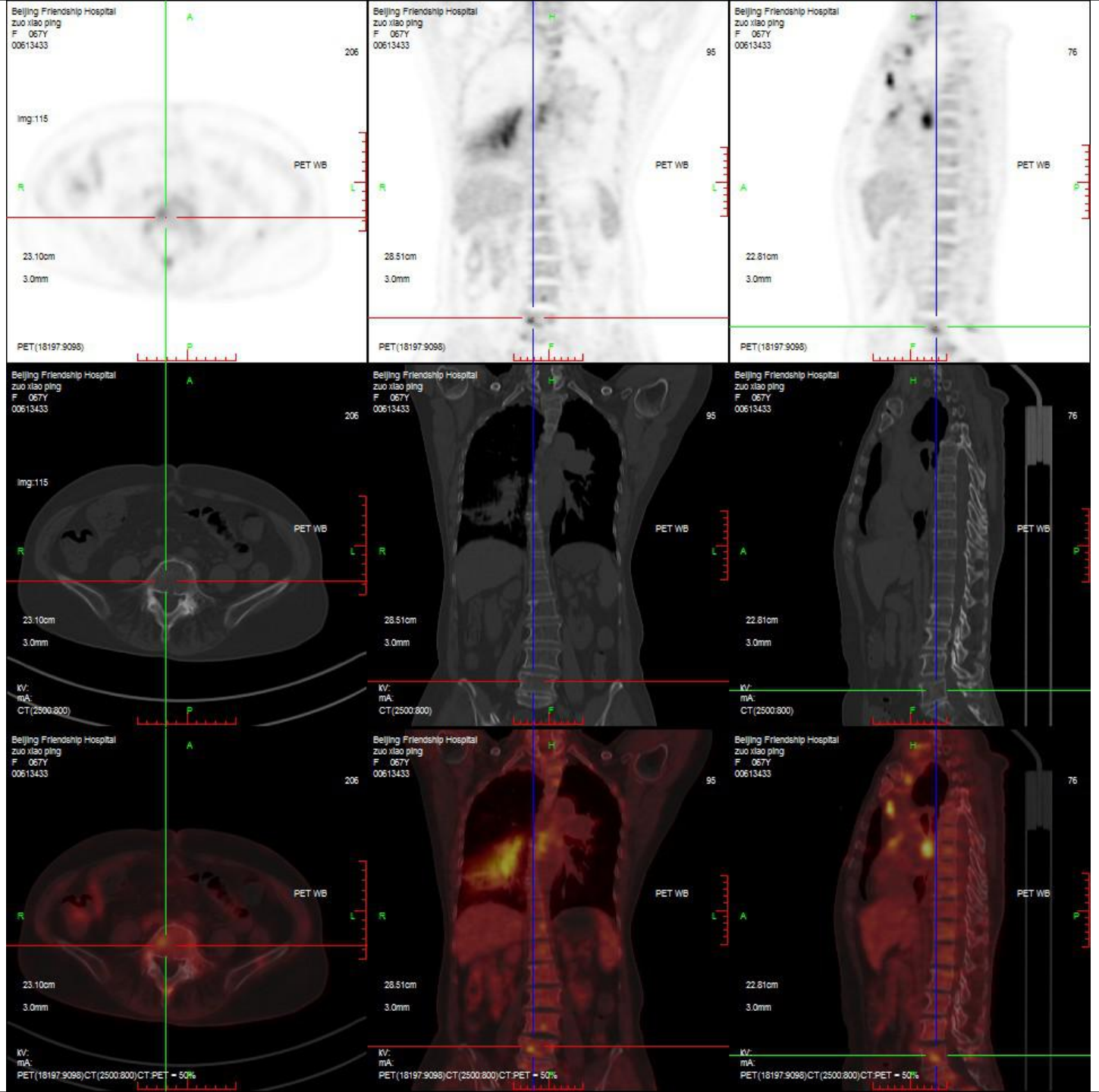
- ✓患者左***，女，67岁，主因“间断咳嗽咳痰2周余。”入院
- ✓患者中老年女性，亚急性病程；
- ✓患者2周余前无明显诱因出现流鼻涕，咽痛，低热，体温为37.2℃，伴畏寒、乏力
- ✓予口服抗感染治疗、化痰治、抗感染治疗，现患者为行进一步治疗收入我科。


Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
H
83
PET WB
R
L
25.00cm
3.0mm
PET(24998:12499)
F


Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
A
123
img:240
PET WB
R
L
48.01cm
3.0mm
kV:
mA:
CT(220:50)
P
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
A
123
PET WB
R
L
48.01cm
3.0mm
kV:
mA:
PET(18197:9098)CT(220:50)CT:PET = 50%
P
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
A
123
img:240
PET WB
R
L
48.01cm
3.0mm
PET(18197:9098)
P
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
H
99
PET WB
R
L
29.84cm
3.0mm
PET(18197:9098)
F


Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
108
img:262
PET WB
52.51cm
3.0mm
kV:
mA:
CT(220:50)
A
P
R
L
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
108
PET WB
52.51cm
3.0mm
kV:
mA:
PET(18197:9098)CT(220:50)CT:PET = 50%
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
108
img:262
PET WB
52.51cm
3.0mm
PET(18197:9098)
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
91
PET WB
27.46cm
3.0mm
PET(18197:9098)
H
F


Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
231
img:157
Thorax 1
11.05cm
1.0mm
kV:
mA:
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
232
img:156
Thorax 1
10.95cm
1.0mm
kV:
mA:
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
120
Thorax 1
12.05cm
1.0mm
kV:
mA:
CT(1500:-500)


Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
206
img:115
PET WB
23.10cm
3.0mm
PET(18197:9098)
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
95
PET WB
28.51cm
3.0mm
PET(18197:9098)
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
76
PET WB
22.81cm
3.0mm
PET(18197:9098)
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
206
img:115
PET WB
23.10cm
3.0mm
kV:
mA:
CT(2500:800)
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
95
PET WB
28.51cm
3.0mm
kV:
mA:
CT(2500:800)
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
76
PET WB
22.81cm
3.0mm
kV:
mA:
CT(2500:800)
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
206
PET WB
23.10cm
3.0mm
kV:
mA:
PET(18197:9098)CT(2500:800)CT:PET = 50%
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
95
PET WB
28.51cm
3.0mm
kV:
mA:
PET(18197:9098)CT(2500:800)CT:PET = 50%
Beijing Friendship Hospital
zuo xiao ping
F 067Y
00613433
76
PET WB
22.81cm
3.0mm
kV:
mA:
PET(18197:9098)CT(2500:800)CT:PET = 50%

PETCT检查结论

病史

右侧乳腺癌术后（浸润型乳腺癌）
超声宫腔内占位 2.2×1.5

检查所见

阴阳性：不确定 阳性 阴性　符合率：不确定 符合 不符合　需要随访　危急值　历史修改记录

禁食状态下（空腹血糖5.4mmol/L），静脉注入药物1小时后行头至腹股沟X-CT透射断层和PET发射断层影像采集。

大脑形态如常，皮层各叶放射性分布均匀。皮层下各神经核团显影清晰，放射性分布对称。同机CT显示双侧颅板下可见液体密度影，左侧为著，最宽处约2.5cm，未见FDG摄取。大脑白质未见明显低密度影，中线无移位。脑室无扩大，基底节区显示对称。小脑显影如常，两侧小脑对称。松果体区可

检查结论

是否示教：是 否

1.右肺下叶病灶伴FDG代谢增高，右肺内多发结节，右肺下叶网格影，首先考虑恶性病变肺内转移、癌性淋巴管炎(T4期)；
右侧锁骨区，纵隔多发淋巴结转移(N3期)；
左侧第3肋、胸骨、胸腰椎多发FDG代谢增高，考虑多发骨转移(M1期)；
右肺下叶支气管管壁增粗，右肺远端阻塞性炎症；
双上肺胸膜增厚、粘连，右肺为著；

2.子宫体积稍大，形态饱满，内可见不规则低密度影，CT值约10Hu，未见FDG异常摄取，建议妇科专科检查。
3.双侧硬膜下积液，左侧为著；
4.胆囊多发结石；
5.左侧髂骨骨岛可能；脊柱退行性改变。
余躯干及脑部PET/CT检查未见明显异常代谢征象。

^{18}F- FDG PET/CT的优点和不足

- 18F- FDG 是一种广谱恶性肿瘤显像剂，是“世纪分子”， 18F- FDG对核医学、对PET的发展具有举足轻重的重要意义，但是18F- FDG也存在美中不足之处，它不是一种特异的肿瘤显像剂。

- 存在假阳性和假阴性

^{18}F-FDG PET鉴别肿瘤良恶性的局限性

- 一些良性病变，如活动性结核病灶、急性炎症、炎性假瘤
- 分化程度较高的原发性肝细胞癌
- 泌尿系统肿瘤
- 部分特殊细胞类型的恶性肿瘤：如印戒细胞癌、粘液囊腺癌、肺泡癌、类癌等
- 甲状腺癌

Idiopathic pulmonary fibrosis

Interstitial lung disease

- ✓ A heterogeneous group of diseases with varying amounts of interstitial inflammation and fibrosis, IPF
- ✓ There is an urgent need for biomarkers and end points in order to develop therapy and treatment regimens for patients with IPF

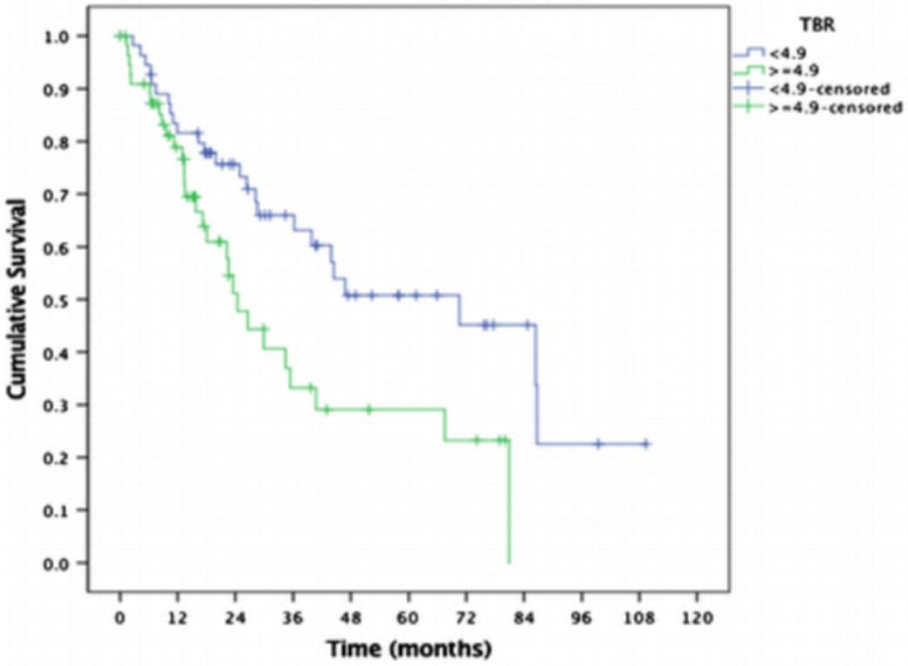
18F-FDG

- ✓ 18F-FDG uptake by tissues is a marker of glucose utilization, correlating with tissue metabolism.
- ✓ On-going metabolic activity, in areas of scarred lung, would indicate a process that could be manipulated therapeutically.

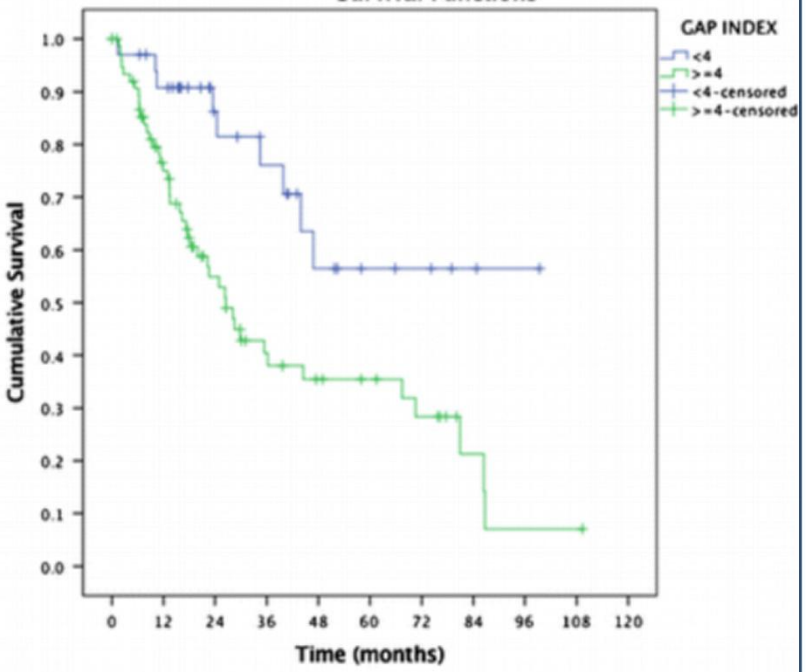
Objective

- ✓ The potential for baseline measures of pulmonary 18F-FDG PET signal to **predict survival** in patients with IPF compared to the **more established GAP (gender age and physiology) prognostic score**.

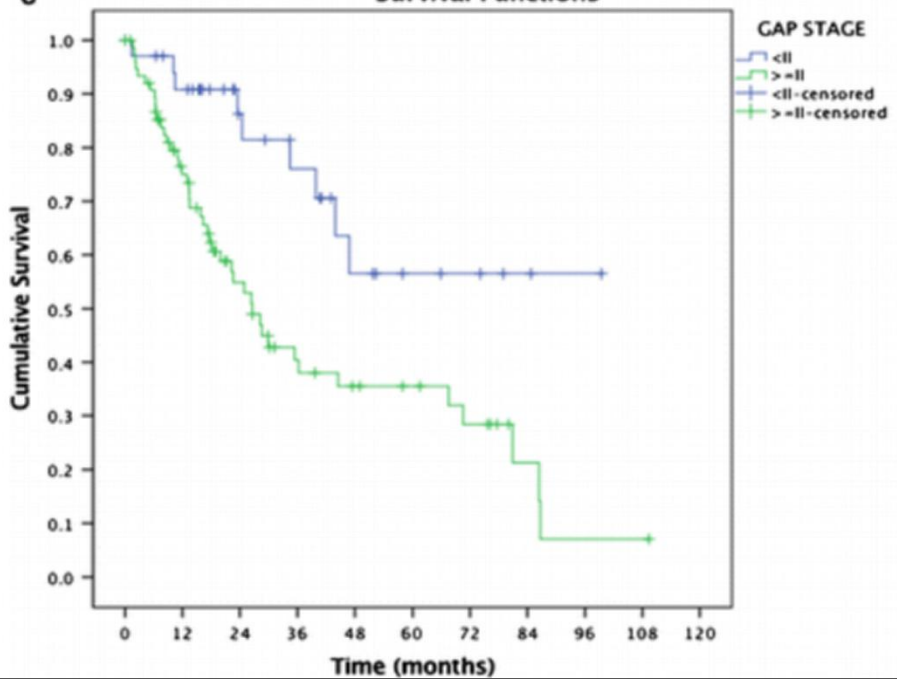
a


Survival Functions
TBR
<4.9
>=4.9
<4.9-censored
>=4.9-censored
Cumulative Survival
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
12
24
36
48
60
72
84
96
108
120
Time (months)

b


Survival Functions
GAP INDEX
<4
>=4
<4-censored
>=4-censored
Cumulative Survival
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
12
24
36
48
60
72
84
96
108
120
Time (months)

c


Survival Functions
GAP STAGE
<II
>=II
<II-censored
>=II-censored
Cumulative Survival
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
12
24
36
48
60
72
84
96
108
120
Time (months)

Conclusion

- ✓ We have shown that high pulmonary uptake of 18F-FDG (TBR) **is associated with mortality** in our population of IPF patients.

Win T, et al. Eur J Nucl Med Mol Imaging. 2018;45(5):806-815.

IgG4-Related Systemic Disease

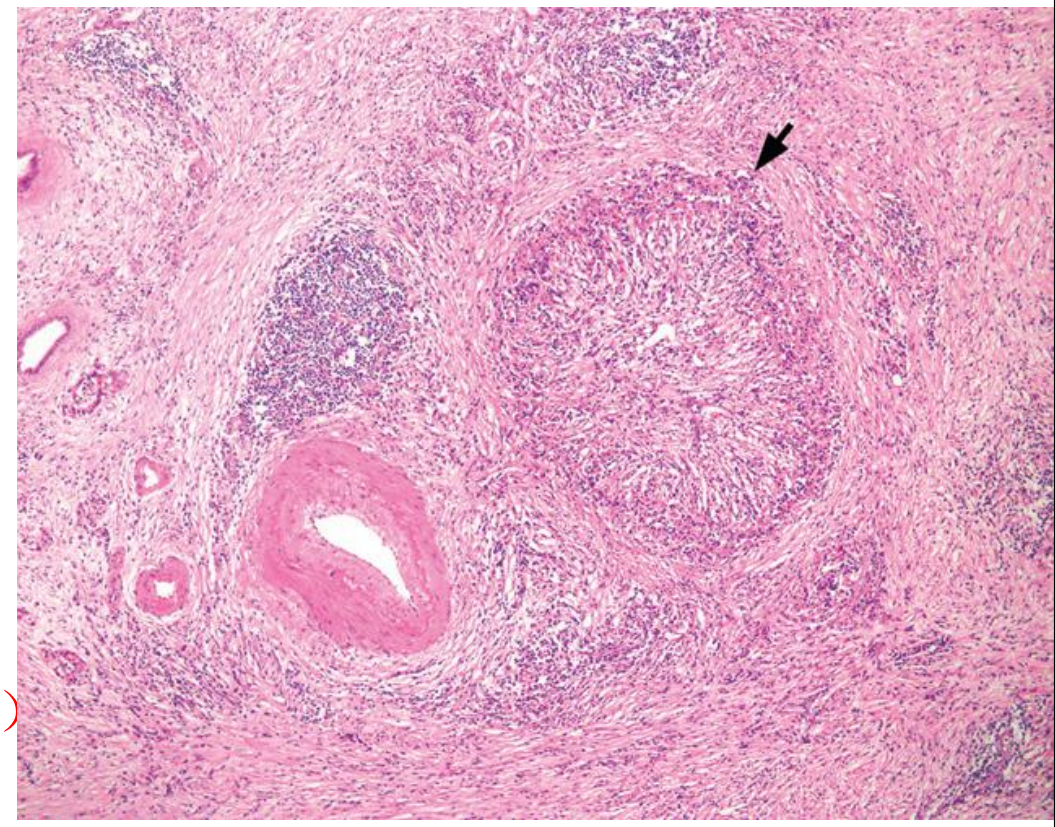
Overview

- **Age**:58-69years, **Male: female**=3:1 (AIP)
- **Symptoms**：non-specific;
- **Pathology features:**

➢lymphoplasmacytic infiltration

➢storiform fibrosis(漩涡样纤维化）

➢obliterative phlebitis(闭塞性静脉炎）



Serology(IgG、γ-Globulin、 AutoAb+）

High serum IgG4 >135mg/dL

- Screening
- Monitor treatment decisions
- neither sensitive nor specific
- 20% type 1 AIP normal
- 4-10% pancreatic cancer

• Histology：

- IgG4+cells>10/hpf;
- IgG4/IgG cells >40%;

- **Morphological change:**

  - Pancreas, kidneys---diffusely enlarged
  - Buctal organs(bile duct, bronchus) ---diffuse wall-thickening

- **Gold standard：**

  - **Tissue biopsy**

Panel 1: Conditions once regarded as individual disorders now recognised to be part of IgG4-related disease

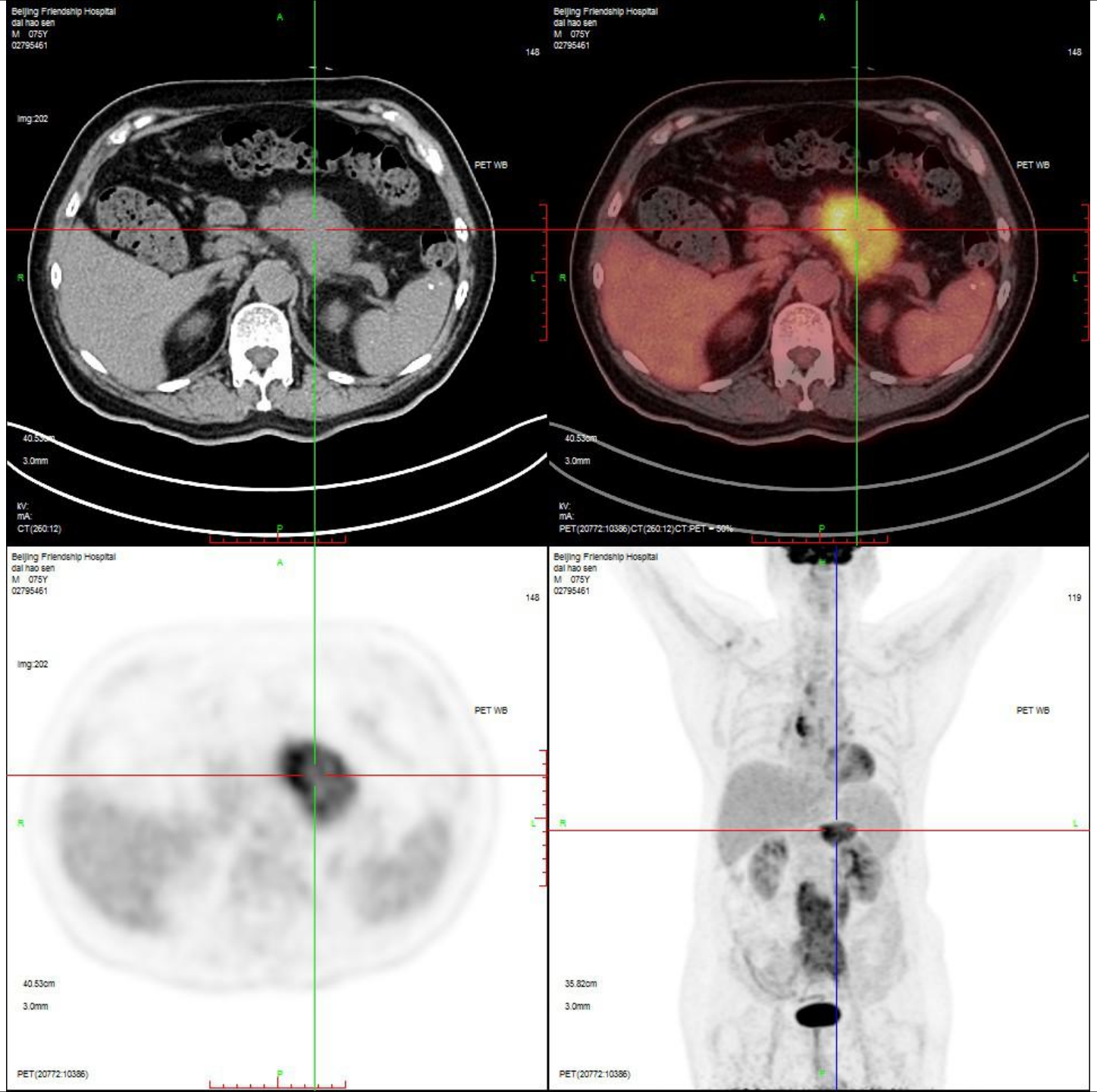
- Autoimmune pancreatitis (lymphoplasmacytic sclerosing pancreatitis)
- Eosinophilic angiocentric fibrosis (affecting the orbits and upper respiratory tract)
- Fibrosing mediastinitis
- Hypertrophic pachymeningitis
- Idiopathic hypocomplementaemic tubulointerstitial nephritis with extensive tubulointerstitial deposits
- Inflammatory pseudotumour (affecting the orbits, lungs, kidneys, and other organs)
- Küttner's tumour (affecting the submandibular glands)
- Mikulicz's disease (affecting the salivary and lacrimal glands)
- Multifocal fibrosclerosis (commonly affecting the orbits, thyroid gland, retroperitoneum, mediastinum, and other tissues and organs)
- Periaortitis and periarteritis
- Inflammatory aortic aneurysm
- Retroperitoneal fibrosis (Ormond's disease)
- Riedel's thyroiditis
- Sclerosing mesenteritis

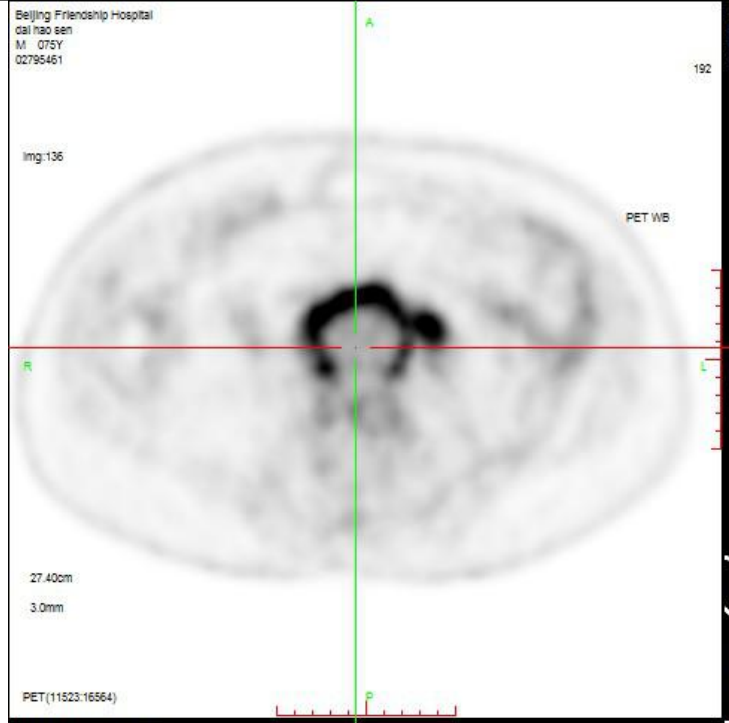
IgG4-related disease. *Lancet* 2015, 385: 1460–71

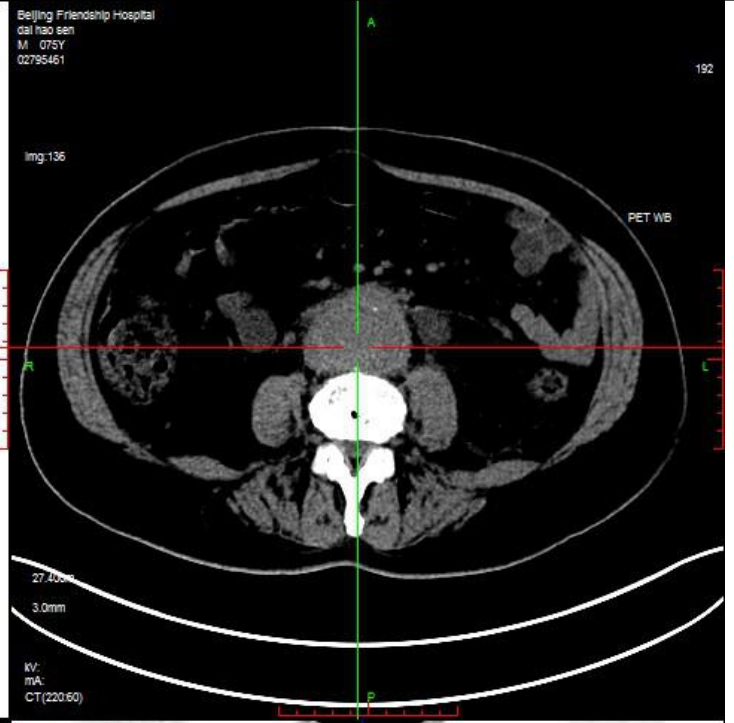
医保外科病例

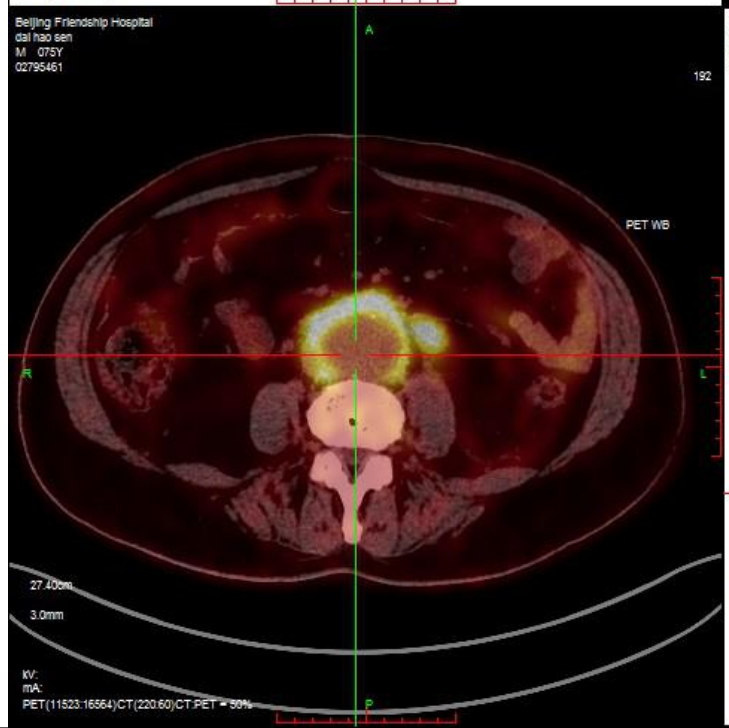
[redacted]根据患者影像学表现，胰腺占位性病变首先考虑为胰腺癌，不排除自身免疫性胰腺炎可能，可完善IgG4行排除诊断。腹主动脉瘤诊断明确，腹主动脉至双侧髂血管周围包裹组织，首先考虑为良性病变，存在因腹主动脉瘤处血浆外渗致周围组织炎性病变可能，不排除腹膜后纤维化及淋巴瘤、转移癌可能。建议行PET/CT检查进一步明确病变性质。

血管外科陈学明主任医师发言：患者腹主动脉瘤诊断明确，内附腹壁血栓，存在手术指征，建议行腹主动脉+双髂动脉支架置入术，保守治疗期间，继续予控制血压，警惕腹主动脉瘤破裂。血管周围病变，不排除腹主动脉瘤曾破裂致周围组织炎性包裹可能，同意贺文主任医师建议，行PET/CT检查进一步明确诊断。

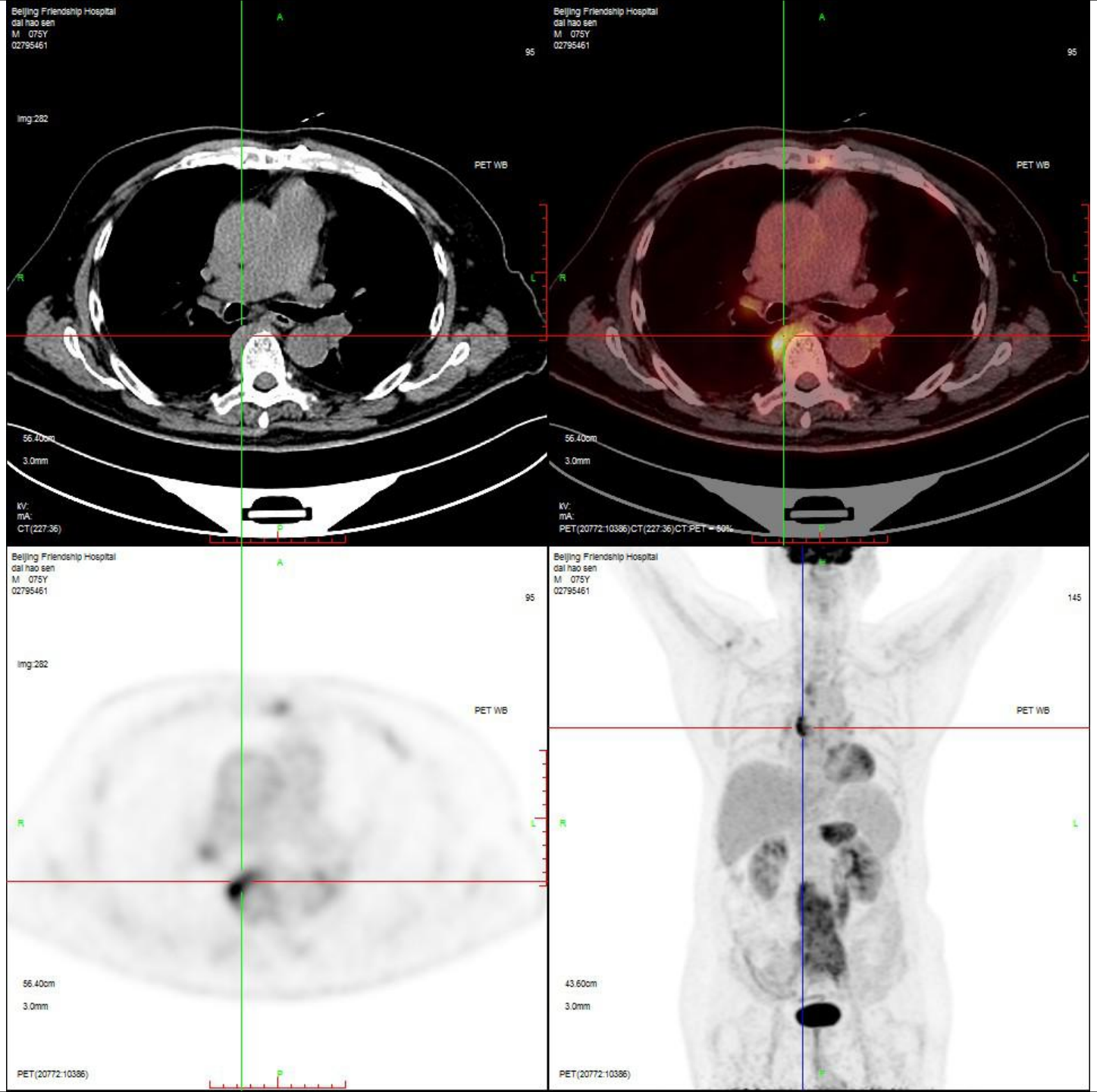

Beijing Friendship Hospital
dai hao sen
M 075Y
02795461
148
img:202
PET WB
40.53cm
3.0mm
kV:
mA:
CT(260:12)
Beijing Friendship Hospital
dai hao sen
M 075Y
02795461
148
PET WB
40.53cm
3.0mm
kV:
mA:
PET(20772:10386)CT(260:12)CT:PET = 50%
Beijing Friendship Hospital
dai hao sen
M 075Y
02795461
148
img:202
PET WB
40.53cm
3.0mm
PET(20772:10386)
Beijing Friendship Hospital
dai hao sen
M 075Y
02795461
119
PET WB
35.82cm
3.0mm
PET(20772:10386)


Beijing Friendship Hospital
dai hao sen
M 075Y
02795461
192
img:136
PET WB
27.40cm
3.0mm
PET(11523:16564)


Beijing Friendship Hospital
dai hao sen
M 075Y
02795461
192
img:136
PET WB
27.40cm
3.0mm
kV:
mA:
CT(220:60)


Beijing Friendship Hospital
dai hao sen
M 075Y
02795461
192
PET WB
27.40cm
3.0mm
kV:
mA:
PET(11523:16564)CT(220:60)CT:PET = 50%


Beijing Friendship Hospital
dai hao sen
M 075Y
02795461
81
PET WB
24.31cm
3.0mm
PET(11523:16564)


Beijing Friendship Hospital
dai hao sen
M 075Y
02795461
95
img:282
PET WB
56.40cm
3.0mm
kV:
mA:
CT(227:36)
Beijing Friendship Hospital
dai hao sen
M 075Y
02795461
95
PET WB
56.40cm
3.0mm
kV:
mA:
PET(20772:10386)CT(227:36)CT:PET = 50%
Beijing Friendship Hospital
dai hao sen
M 075Y
02795461
95
img:282
PET WB
56.40cm
3.0mm
PET(20772:10386)
Beijing Friendship Hospital
dai hao sen
M 075Y
02795461
145
PET WB
43.60cm
3.0mm
PET(20772:10386)

检查结论

是否示教： ○ 是 ◉ 否

1.胰腺体尾部局部增大，FDG代谢增高，考虑自身免疫性胰腺炎可能；
腹主动脉中下段及双侧髂总动脉周围可见软组织密度影包绕，FDG代谢增高，考虑腹膜后纤维化；病灶累及左侧输尿管，致左肾及左侧输尿管积水。
T3-6椎体右前方条形软组织密度影，FDG代谢明显增高，考虑为纵隔纤维化；
建议治疗后复查PET/CT。
2.腔隙性脑梗塞；
松果体、脉络丛及大脑镰钙化灶；
老年性脑改变。
3.双侧上颌窦内可见少许软组织密度影，未见FDG异常代谢，考虑上颌窦炎可能。
4.左肺上叶、右肺下叶微结节，未见FDG异常代谢，建议动态观察；
双下肺多发斑片、索条影，未见FDG异常代谢，考虑为慢性炎症可能；
右肺上叶肺大泡；
右肺尖钙化灶。
5.腹主动脉中下段增宽，考虑腹主动脉瘤；
胆囊多发结石；
肝脏、脾脏及肾脏多发点状钙化。
6.前列腺增生，FDG代谢不均匀增高，建议必要时完善前列腺核磁检查。
7.脊柱退变；
腰2-4椎体可见小低密度灶，未见FDG异常代谢，考虑许莫氏结节；
左侧髂骨致密影，未见FDG异常代谢，良性病变可能，建议动态观察。
8.余躯干及脑部PET/CT检查未见明显异常代谢征象。

Unexpected Fibrosing Mediastinitis Shown on FDG PET/CT in a Patient With IgG4-Related Disease

Ying Kan, MD, Leilei Yuan, MD, PhD, Wei Wang, MD, PhD, and Jigang Yang, MD, PhD

Abstract: A 66-year-old man presented to our hospital because of abdominal pain for 5 days. A contrast abdominal CT raised the possibility of pancreatic carcinoma. FDG PET/CT showed increased FDG accumulation not only in the pancreas and the retroperitoneum, but also in the posterior mediastinum, which was not typical of pancreatic carcinoma. The patient was subsequently diagnosed having immunoglobulin G4–related disease following the histopathologic examination.

Key Words: ^{18}F-FDG, fibrous mediastinitis, IgG4-related disease, PET/CT

(*Clin Nucl Med* 2017;42: 818–819)

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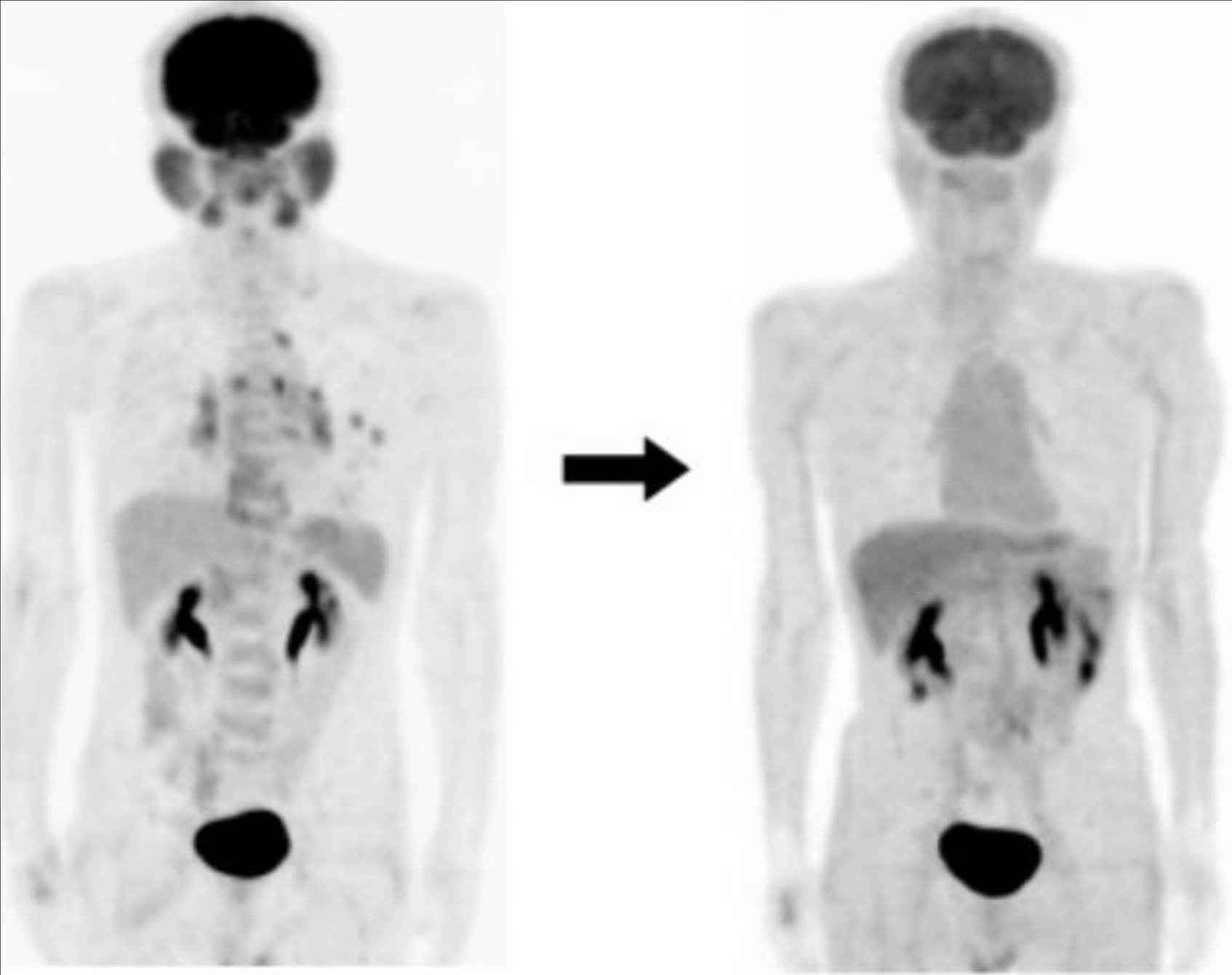
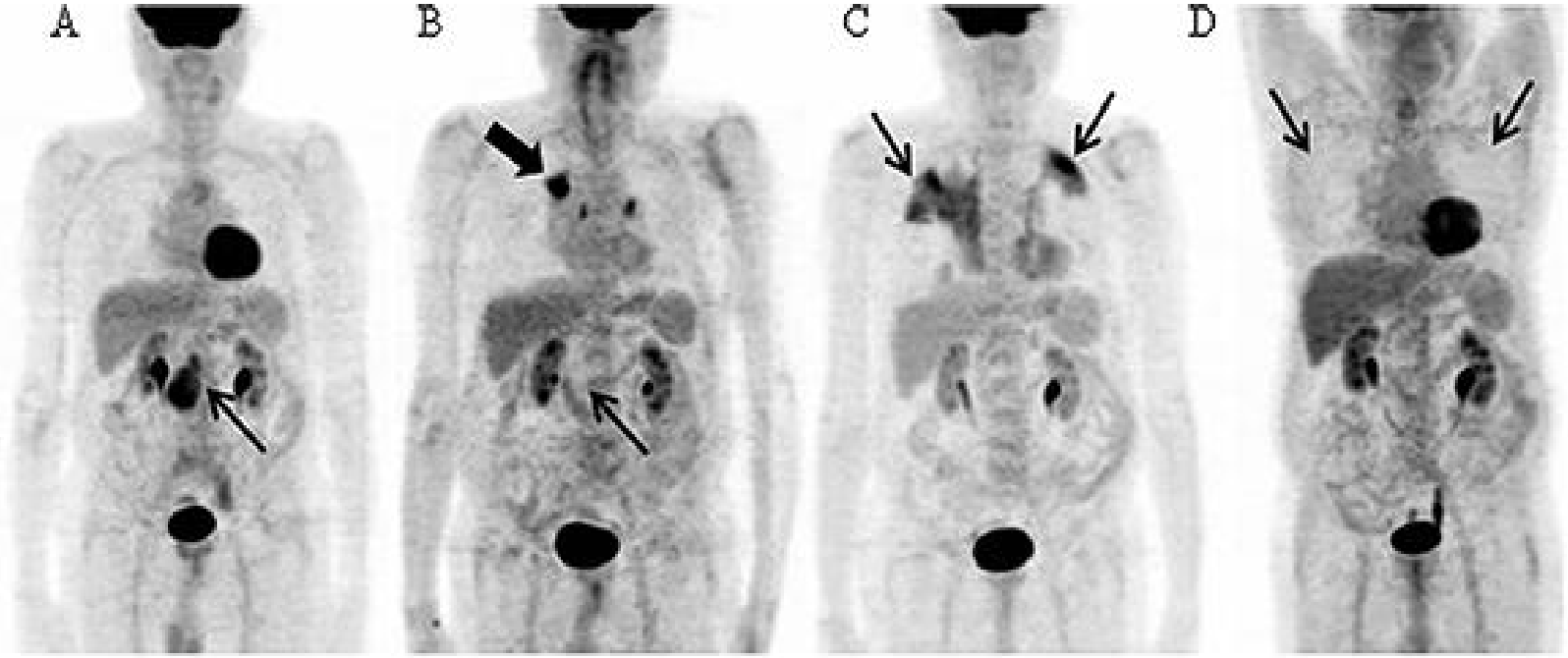


Joint Bone Spine. 2014 ; 81(4):331-6.

Usefulness of PET/CT for Staging and Evaluation of Treatment Response in IgG4-Related Disease: A Retrospective Multicenter Study



Arthritis Care & Research 66 1 86-96

Role of FDG PET/CT in IgG4-RD

- The intensity of FDG uptake **cannot always distinguish** between malignant and benign disorders
- define **the extent of organ involvement**
- helpful in **monitoring disease activity after treatment**
- helpful adjunct for **detecting an adequate biopsy site**

Table 2 Summary of the image characteristics that form the pattern of IgG4-related disease on ^{18}F-FDG PET/CT

Image characteristics	Confidence for indication of IgG4-RD
1. Diffusely elevated ^{18}F-FDG uptake in organs, mainly involving salivary glands, pancreas, and prostate	
(1) Evenly, symmetrically distributed ^{18}F-FDG uptake in the salivary glands without signs of infection	Strong
(2) Diffusely enlarged pancreas with moderate to intense ^{18}F-FDG uptake without pancreaticobiliary duct obstruction	Strong
(3) Diffusely enlarged prostate with moderate to intense ^{18}F-FDG uptake	Moderate
(4) Broadly involved lymph nodes with moderate to intense ^{18}F-FDG uptake	Moderate
2. Patchy ^{18}F-FDG-avid lesion without signs of infection, mainly involving aorta wall, retroperitoneal region, pancreas, bile duct, liver, kidney, and lung	
(5) Patchy thickness of aorta wall with moderate to intense ^{18}F-FDG uptake not limited to the vascular intima	Strong
(6) Patchy retroperitoneal lesion with moderate to intense ^{18}F-FDG uptake	Strong
(7) Patchy pancreatic lesion	Moderate
(8) Patchy bile duct lesion	Moderate
(9) Patchy liver lesion	Moderate
(10) Patchy lesions in the enlarged irregular kidneys	Moderate
(11) Patchy lung lesion	Weak
(12) Patchy pleural lesion	Weak
(13) Patchy pericardial lesion	Weak
3. Multi-organ involvement, including the following characteristics besides the above-mentioned	
(14) Pancreas nodule or mass	Weak
(15) Kidney nodule or mass	Weak
(16) Lung nodule(s)	Weak
4. Rapid, significant response to steroid-based treatment	
(17) The ^{18}F-FDG-avid lesions had more than 80 % decrease of activity after 2 to 4 weeks of steroid-based treatment at a dosage of 40 mg to 50 mg prednisone per day	Strong

Characterizing IgG4-related disease with 18F-FDG PET/CT:a prospective cohort study.***ENMMI 2014,41:1624–1634***

Fever of Unknown Origin

FUO

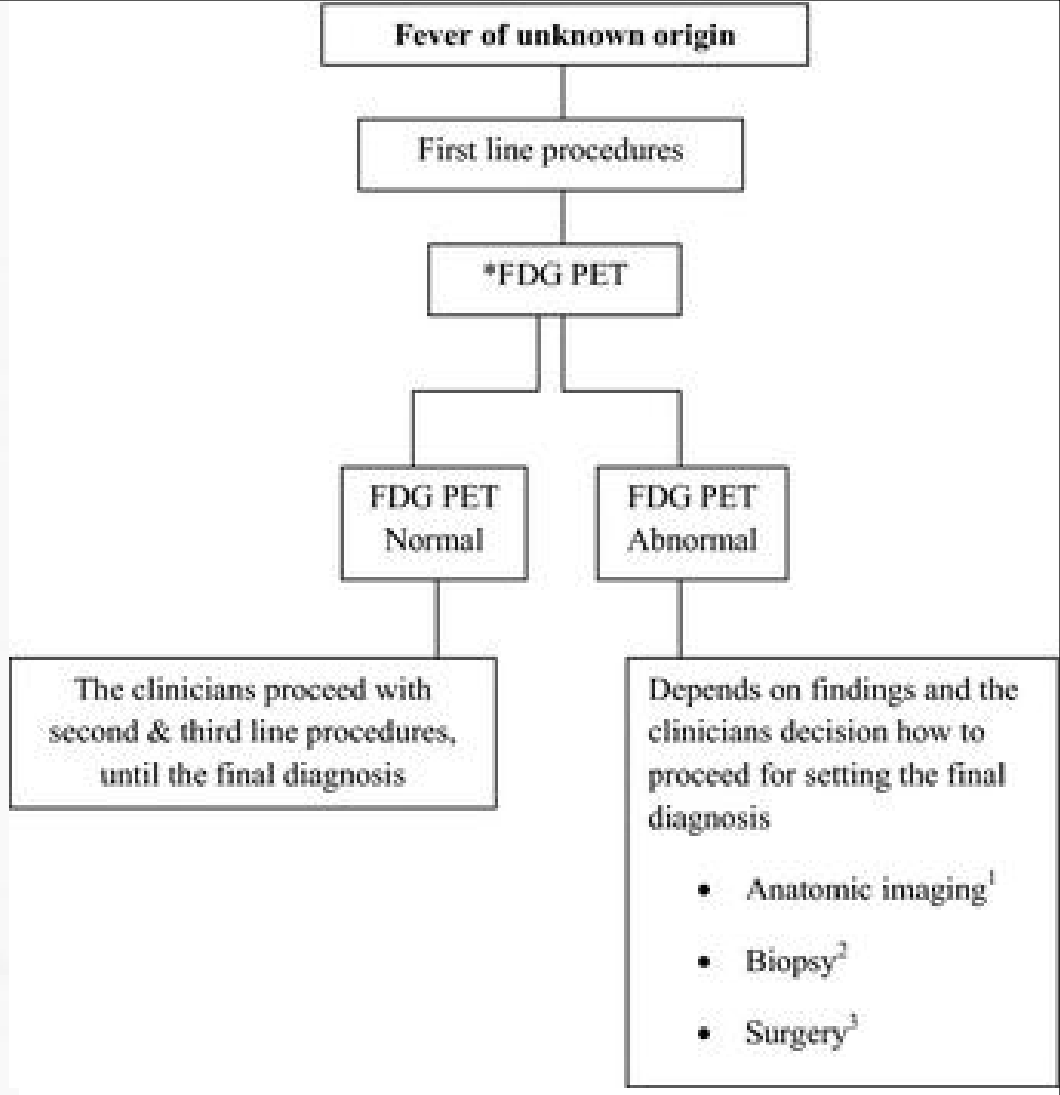
- Petersdorf and Beeson 52 years ago (1961), defined fever of unknown origin (FUO)
- fever higher than 38.3 ° C,
- lasting more than 3 weeks,
- remaining undiagnosed after 1 week of thorough investigation.

Cause

- FUO may occur in 16–45% of infections
- in 17–55% of noninfectious inflammatory processes
- approximately in 3–19% of malignancies
- In 3–10% of cases, it is due to other miscellaneous causes

Evaluation of FUO

- Detailed medical history, full physical examination
- Complete blood count, serum biochemistry analysis
- Urine culture, chest radiography and abdominal ultrasonography
- Further imaging procedures, serum antibodies, are included as second-line procedures
- Third-line procedures, including biopsy and exploratory surgery



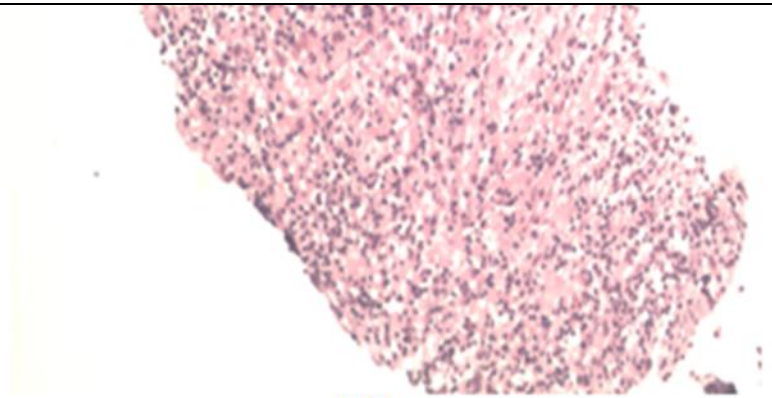
Sioka C et al. **The diagnostic role of (18)F fluorodeoxyglucose positron emission tomography in patients with fever of unknown origin.** Eur J Clin Invest. 2015;45(6):601-8.

Selection of imaging procedure

- CT scan may be performed after negative chest X-ray and abdominal ultrasonography
- Followed by 111indium or 99mTc granulocyte SPECT to rule out abscesses
- 18F-FDG PET/CT scan if all other tests remain unrevealing

Case

- 患者**，男，64岁，主因“间断发热4月，再发6天”于2016年09月22日入院。



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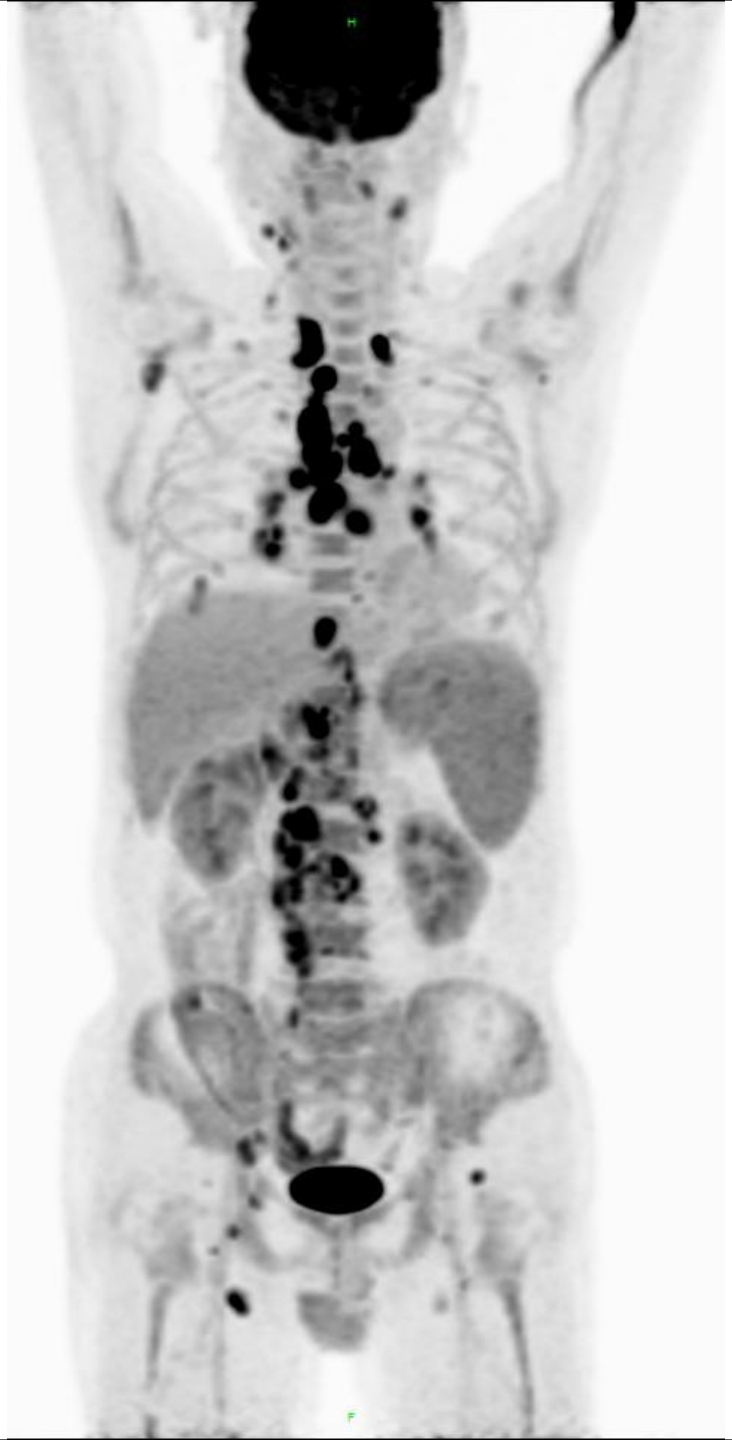
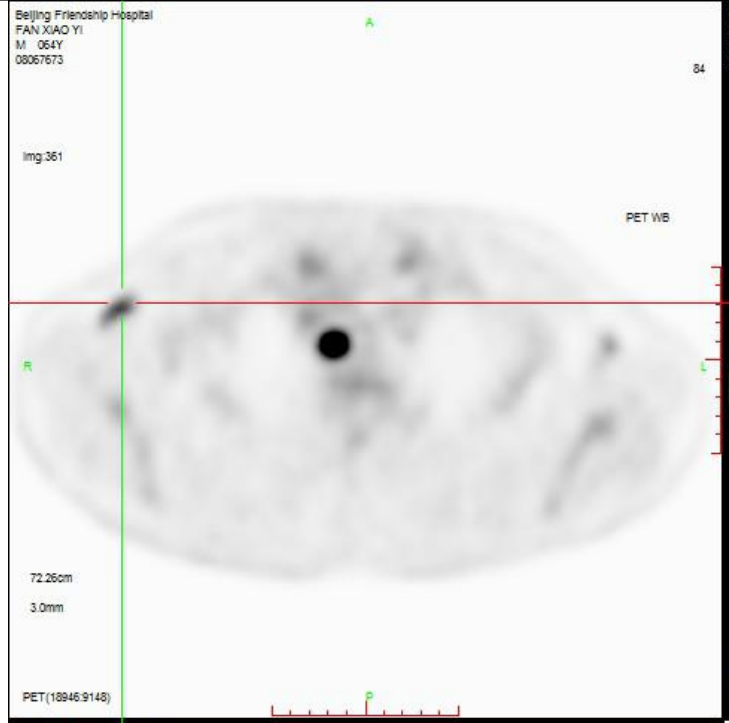
诊断意见:
（腹股沟淋巴结）穿刺淋巴组织2条，镜下见小淋巴细胞、组织细胞及浆细胞，并见散在核大之细胞。免疫组化：CD3+，CD20部分+，CD21少量+，ki67约30%，CD30-，CD15散在+，Pax-5散在+，Oct-2散在+，Bob-1散在+，Bcl-6散在+。原位杂交：EBER-。诊断：淋巴组织增生，伴T细胞增多，请结合临床，必要时再取活检。（本例经周小鸽主任阅片）

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PET WB
R
L
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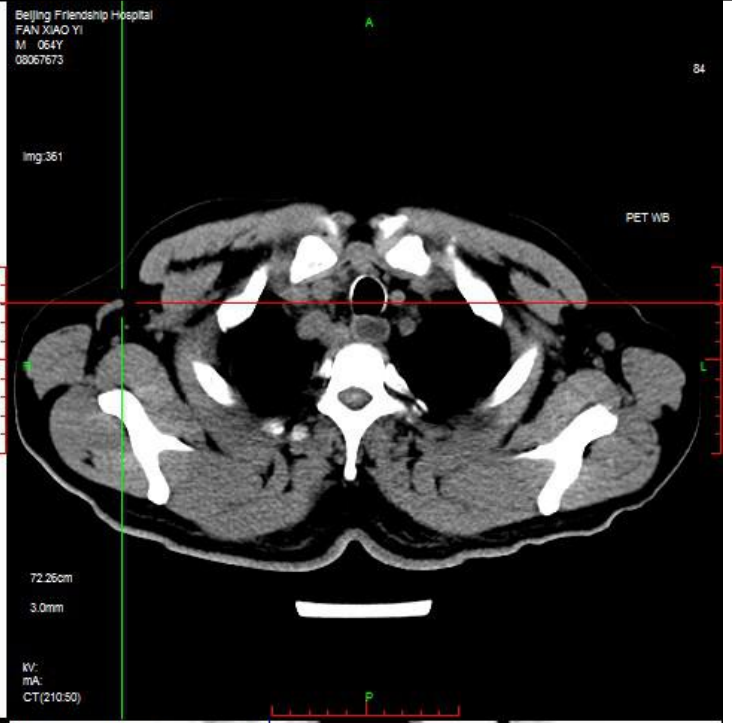
3.0mm
PET(18946:9148)
P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CT(210:50)
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Beijing Friendship Hospital
FAN XIAO YI
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PET WB
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mA:
PET(18946:9148)CT(210:50)CT:PET = 50%
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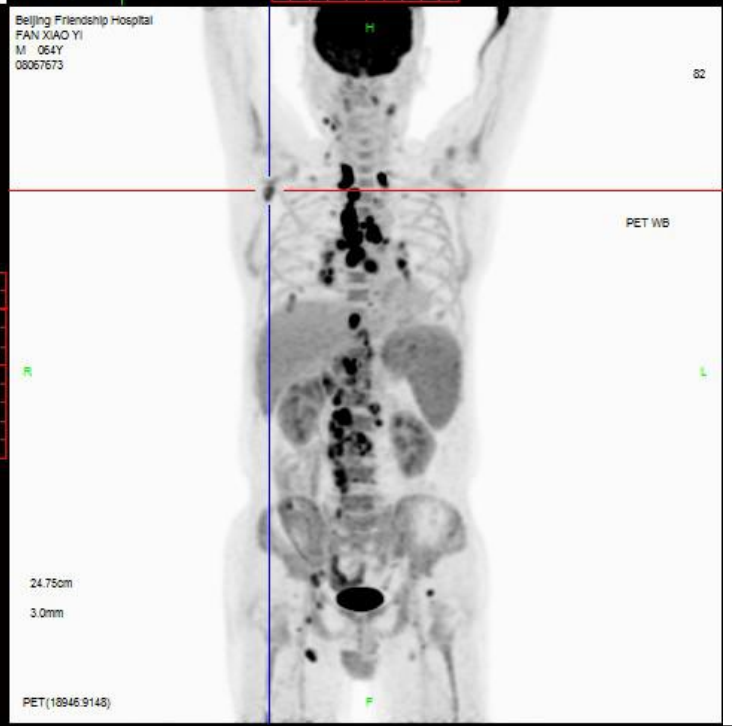
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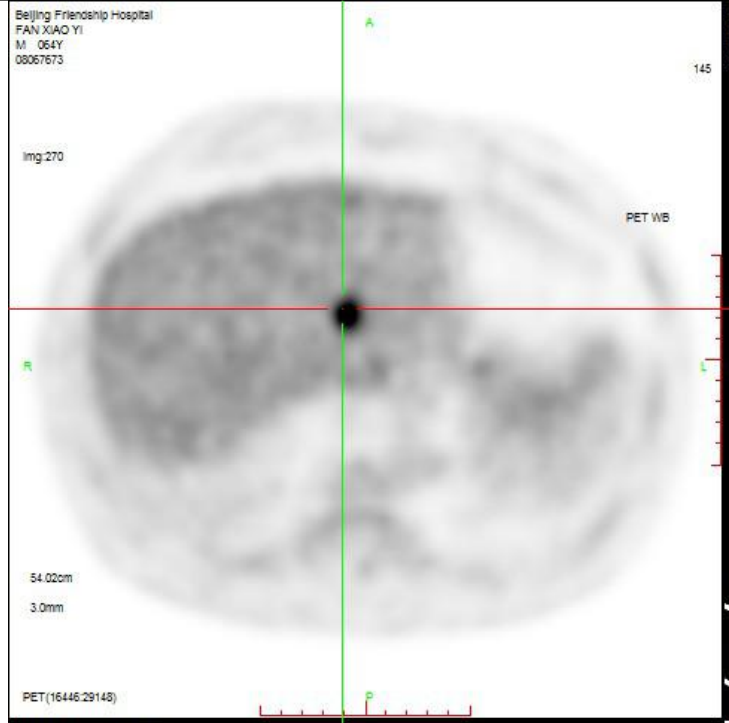
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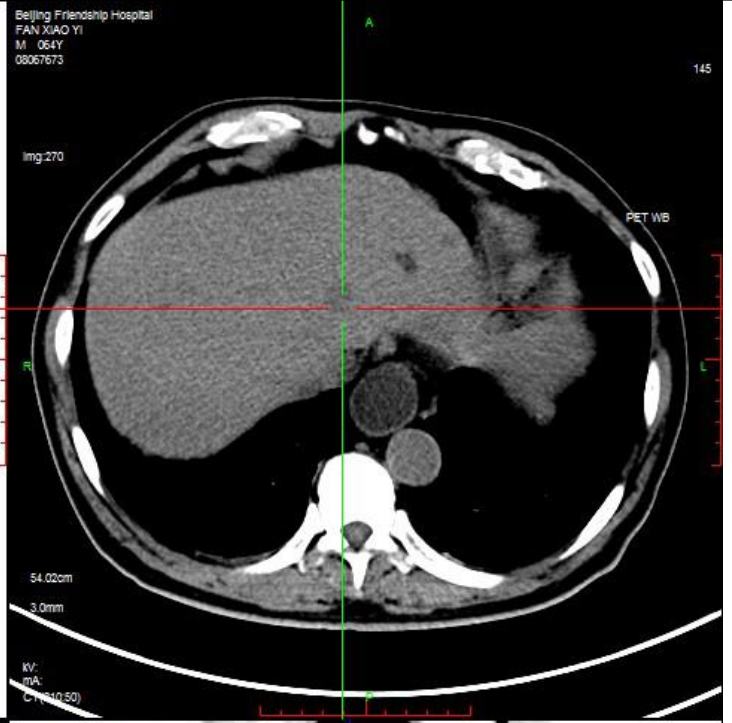
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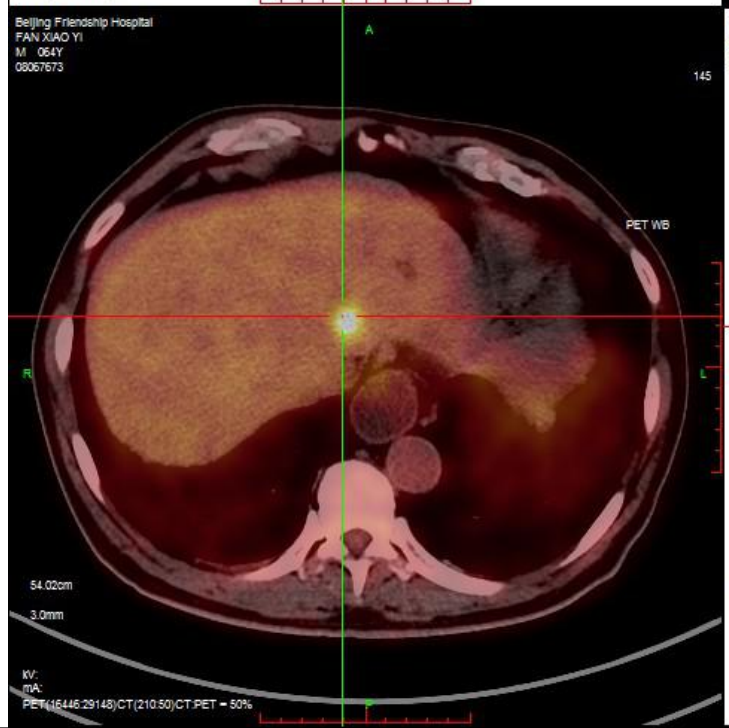
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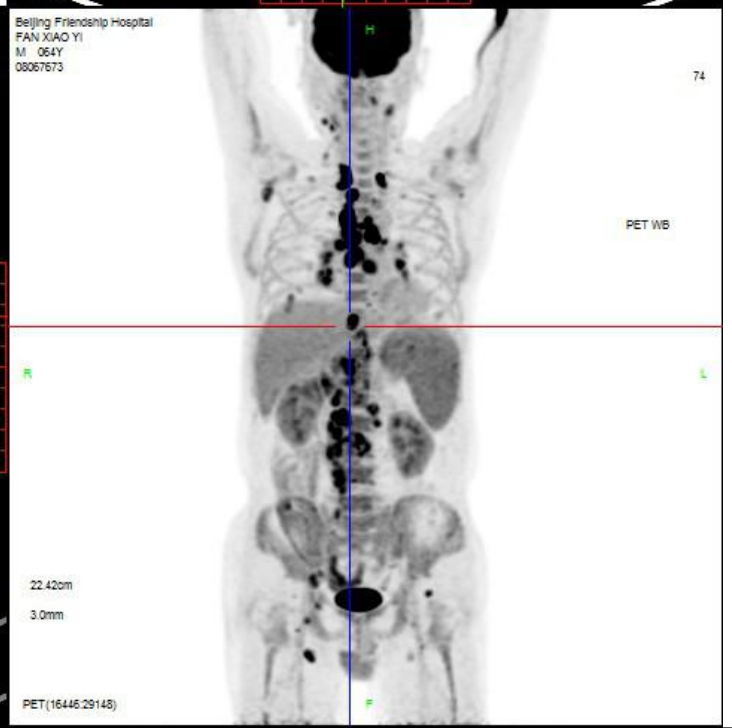
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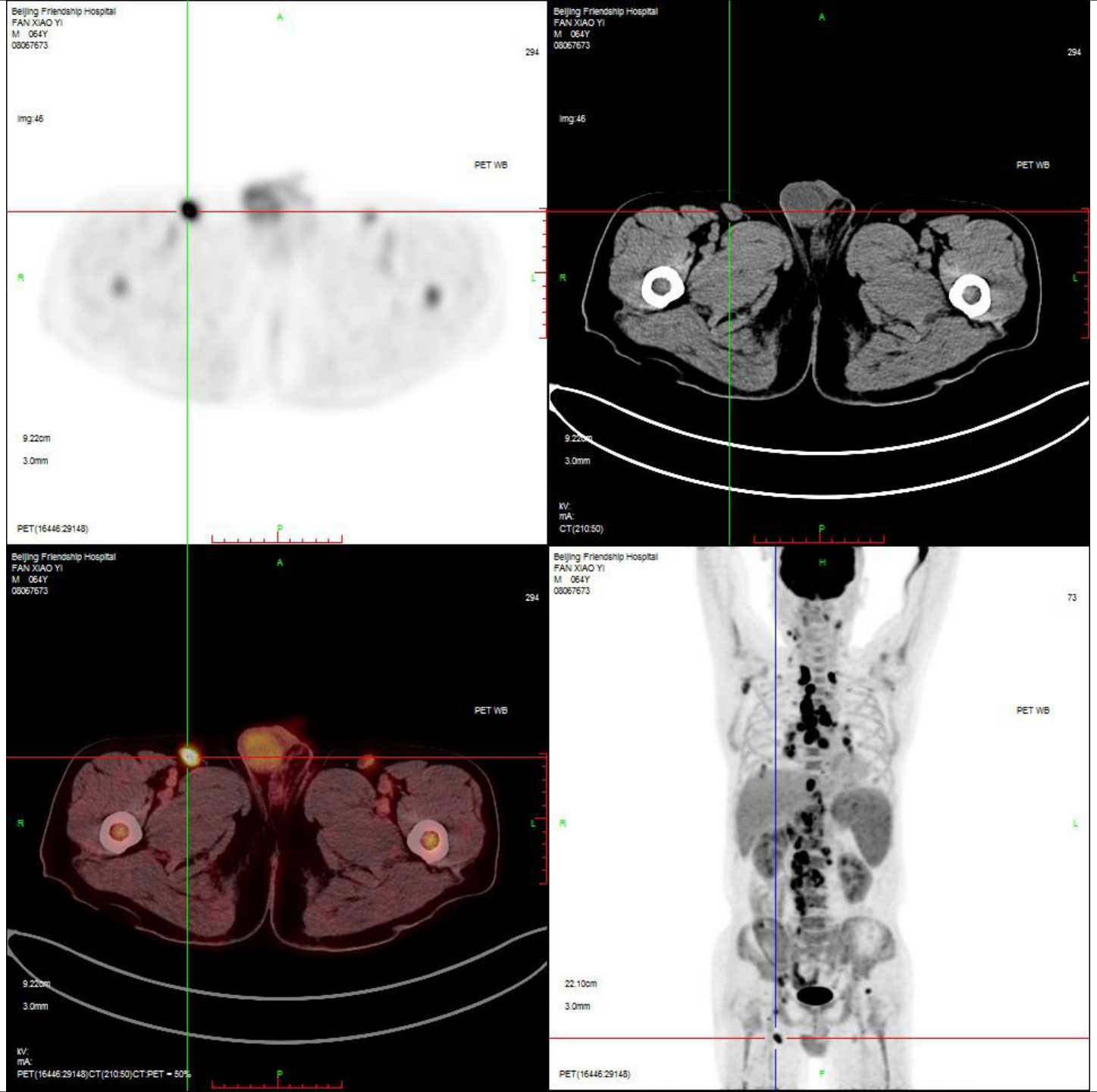
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PET(16446:29148)
Beijing Friendship Hospital
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Beijing Friendship Hospital
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PET(16446:29148)CT(210:50)CT:PET = 50%
Beijing Friendship Hospital
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3.0mm
PET(16446:29148)

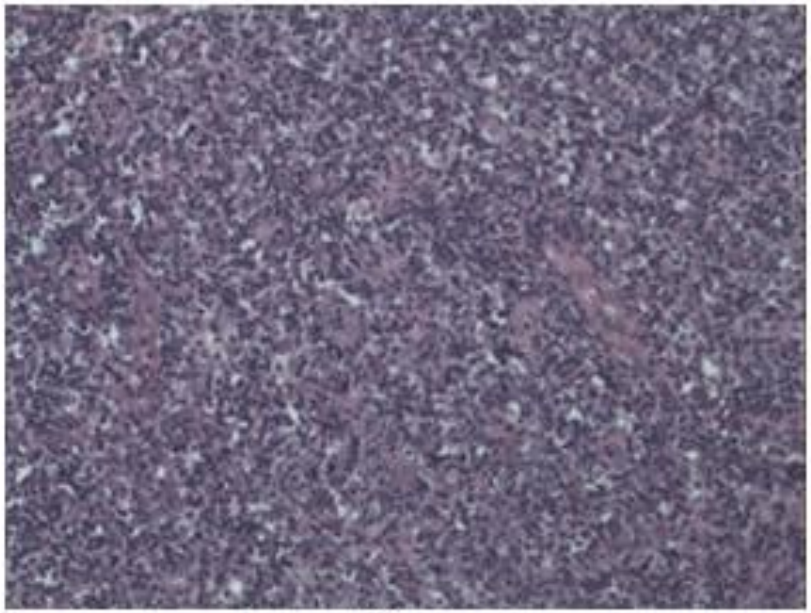
PET/CT检查结论

禁食状态下（空腹血糖6.4mmol/L），静脉注入药物1小时后行头至腹股沟X-CT透射断层和PET发射断层影像采集。

大脑形态如常，皮层各叶放射性分布均匀。皮层下各神经核团显影清晰，放射性分布对称。同机CT显示大脑右侧基底节区可见多发点状、片状低密度灶，未见FDG异常摄取。大脑灰质沟回未见明显增宽加深，白质未见明显低密度影，中线无移位。脑室无扩大，基底节区显示对称。小脑显影如常，两

是否示教： ○ 是 ● 否

1. 全身多发淋巴结肿大，FDG代谢显著增高；
   肝SIV及SVIII稍低密度灶，FDG代谢显著增高；
   扫描野内中轴骨以及四肢骨近端FDG代谢弥漫增高，髓腔骨质密度稍增高；
   脾肿大，FDG代谢弥漫增高；
   综合以上所见，考虑恶性病变-淋巴瘤（肝脏、骨受累）可能性大，建议进一步检查明确。
2. 多发性腔隙性脑梗塞；
   松果体及双侧脉络丛钙化灶。
3. 左侧上颌窦炎；
   口咽部右侧软组织略增厚，两侧腺体代谢略增高，首先考虑炎性或反应性摄取，建议动态观察；
   甲状腺右侧叶多发结节，未见FDG异常代谢，建议必要时进一步检查。
4. 双肺肺气肿；
   右肺上叶前段胸膜下结节，双肺索条影，双侧胸膜局限性增厚，均未见FDG异常代谢。
5. 肝SII及SIV多发低密度灶，未见FDG异常代谢，考虑肝囊肿。
6. 余躯干及脑部PET/CT检查未见明显异常代谢征象。



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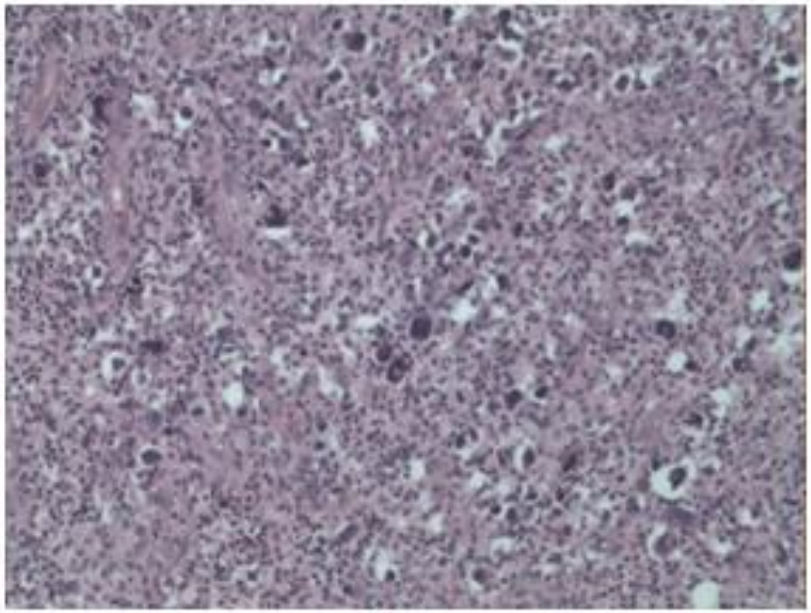

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诊断意见:

（右侧颈部）淋巴结6枚（直径0.2cm-0.8cm），其中1枚淋巴细胞弥漫生长，内散见核大异型之肿瘤细胞，免疫组化： CD3-，CD20-/+，CD21-，CD15+，CD30+，CD10-，ALK-，CD2-，Pax-5+，BOB-1-/+，OCT-2+，Bcl-6+，Bcl-2-，GrB-，CD8-，CD4-，GranB-，Mum-1+，Ki-67约60%+，LMP-，LCA-。EB病毒原位杂交：EBER-。诊断：富于肿瘤细胞的霍奇金淋巴瘤，混合细胞型。其余淋巴结呈反应性增生，内散见各别核大细胞。（本例经周小鸽主任会诊）

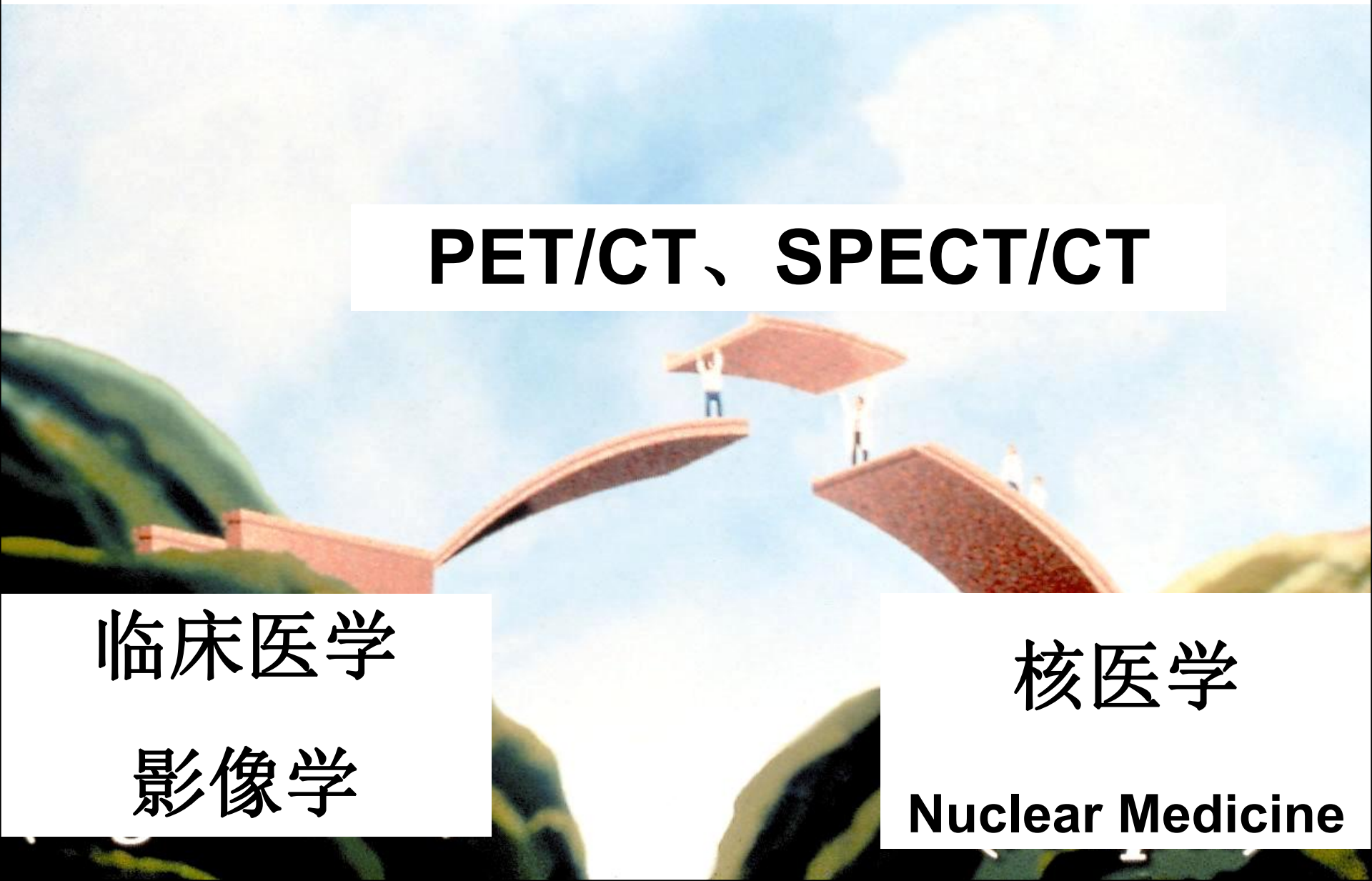
治疗

核医学治疗项目

◆核医学治疗

- 放射性核素治疗：131I治疗甲亢、甲癌、89Sr治疗骨转移
- 99Tc-MDP（云克）治疗RA：不是放射性核素

核医学与临床医学之间的桥梁



PET/CT、SPECT/CT

临床医学

影像学

核医学

Nuclear Medicine

遇到疑难杂症的时候，就找核医学

核医学会给大家惊喜

让我们与核医学共同进步！

谢谢！