



SPECT & PET INTRODUCTION

B99901084 林晉毅

B99901112 顏禎佑

B99901156 林政霖

OUTLINE

- Types of medical imaging
- SPECT
- PET
- Comparison



TYPES OF MEDICAL IMAGING

- X-ray
- Radionuclide(核醫) – SPECT / PET
- MRI
- Ultrasound
- Optical laser



SINGLE-PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

- A SPECT scan is a type of nuclear imaging test that shows how blood flows to tissues and organs.



HOW IT WORKS?

- gamma-emitting radioisotope (放射性同位素)
ex: iodine-131, technetium-99m, xenon-133, thallium-201, and fluorine-18
- gamma-camera



HOW IT WORKS?



WHAT DOES A SPECT SHOW?

- Application 2: brain scan

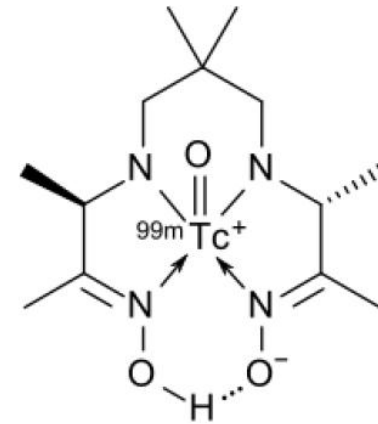
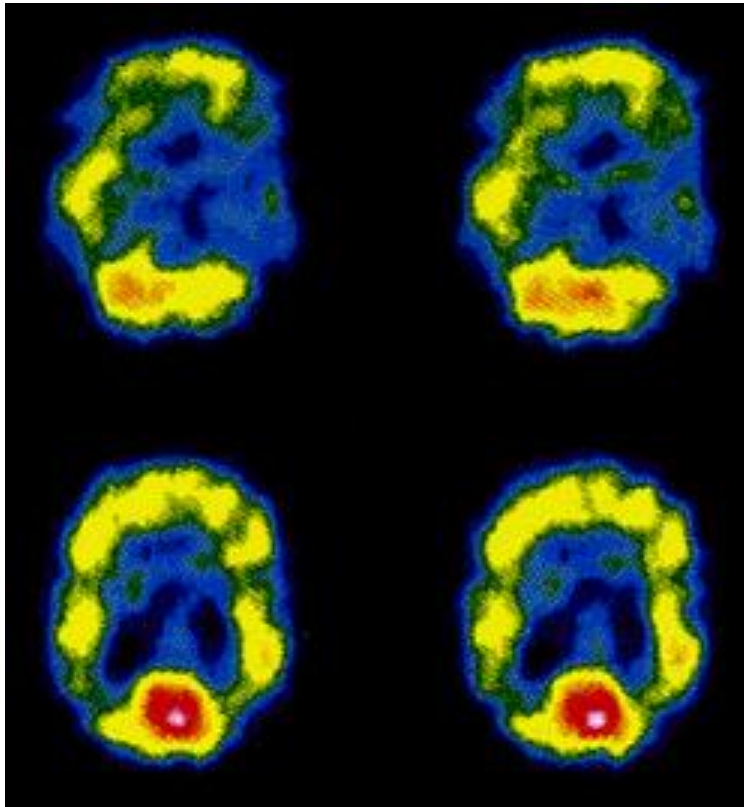
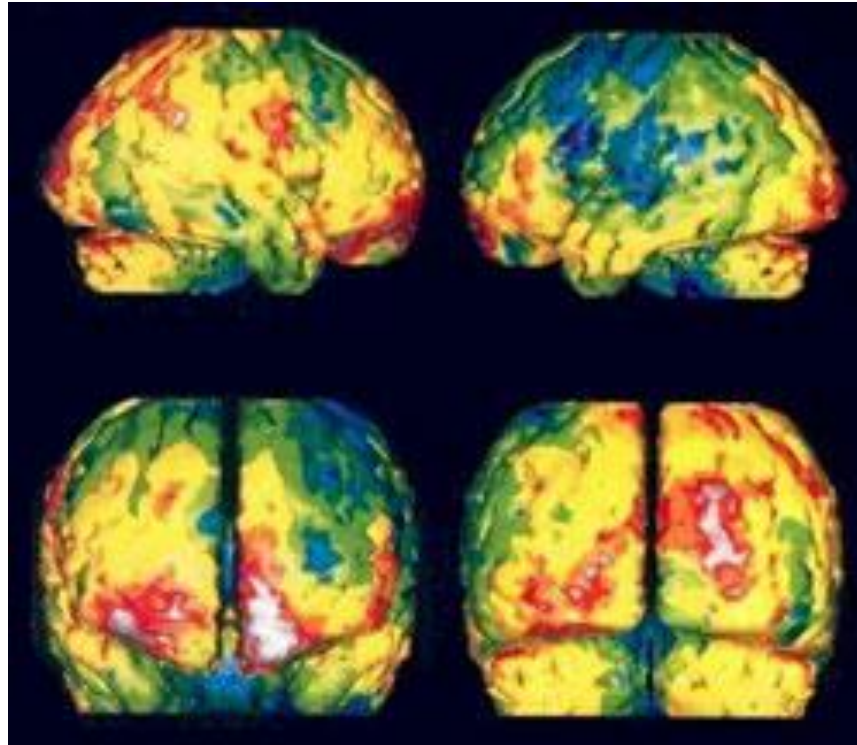


圖 40 ^{99m}Tc -HMPAO



WHAT DOES A SPECT SHOW?



WHAT ARE THE RISKS?

- The amount of radiation your body is exposed to is less than you receive during a chest X-ray or CT scan.
- Women who are pregnant or nursing should not undergo a SPECT scan.



PET



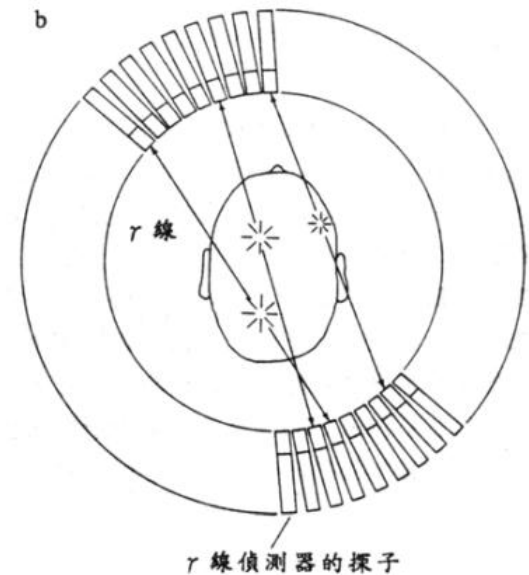
POSITRON EMISSION TOMOGRAPHY(PET)

- A nuclear medical imaging technique that produces a three-dimensional image or picture of functional processes in the body.



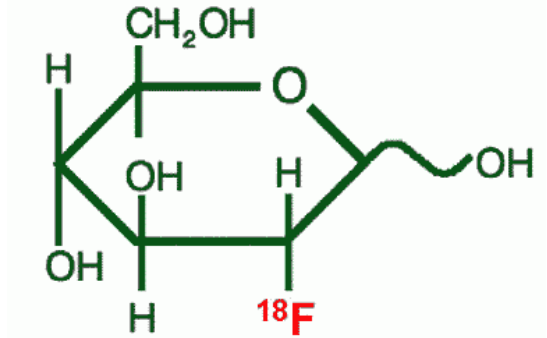
HOW DOES IT WORK?

- positron-emitting radionuclide(tracer)
ex: FDG



HOW DOES IT WORK?

- FDG : 2-deoxy-2-[¹⁸F]fluoroglucose
- 正子標記之去氧葡萄糖



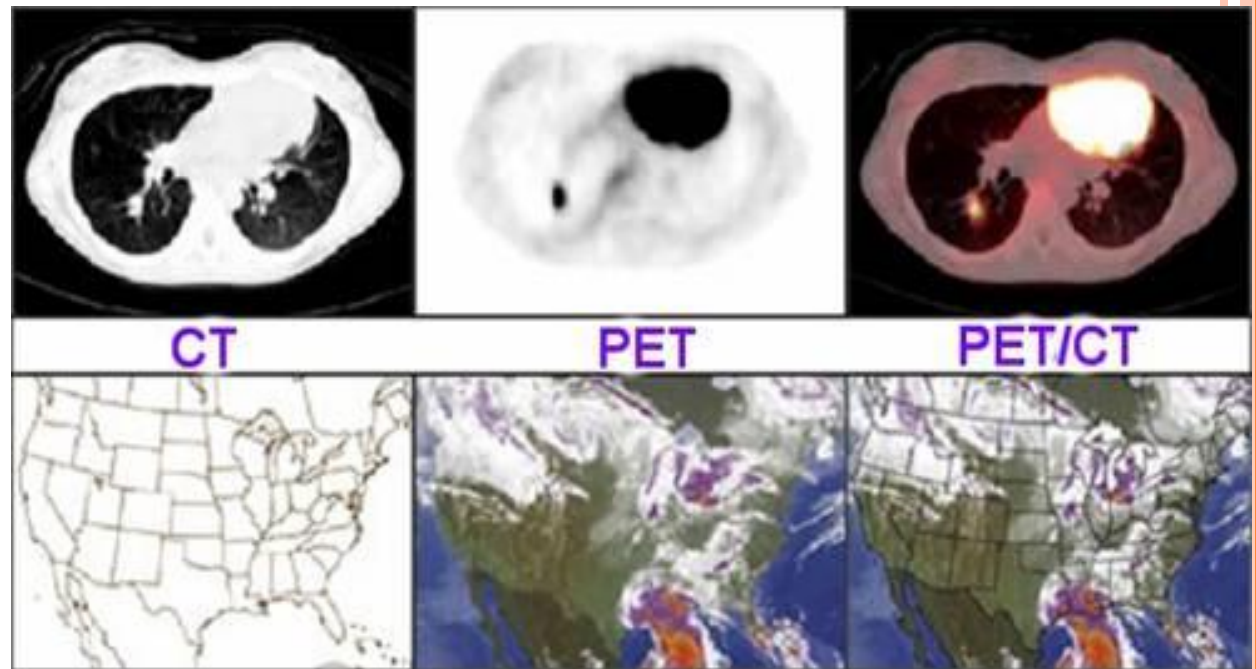
HOW DOES IT WORK?

- The production of FDG



WHAT DOES A PET/CT SHOW?

- PET 掃描組織代謝變化，影像呈現明顯亮點
- 群聚癌細胞需超過 0.5 cm
- CT定位解剖影像



WHAT DOES A PET/CT SHOW?

- 3'18
- <http://www.youtube.com/watch?v=qCT3KQitrCQ>



APPLICATION

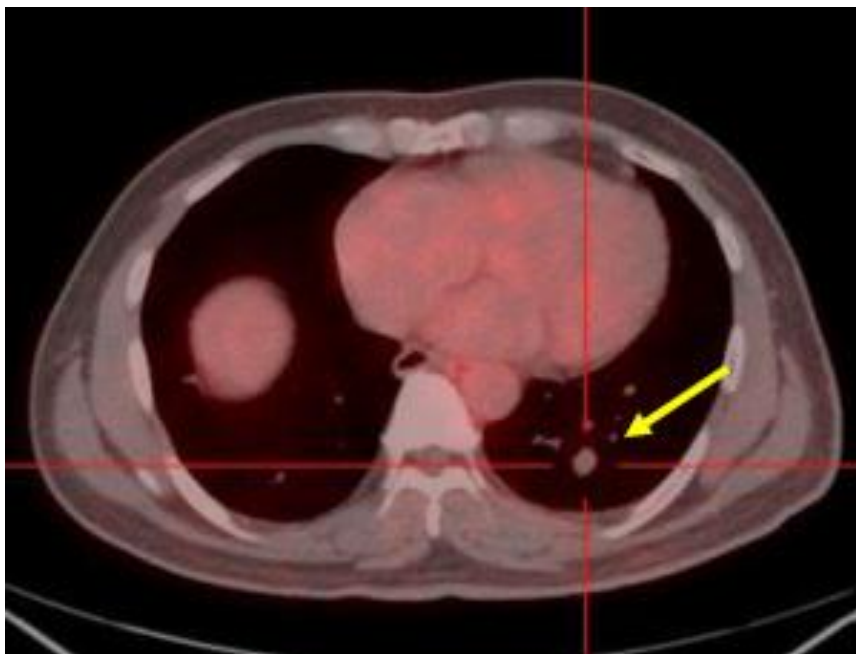
(1) 腫瘤方面

- 偵測早期癌細胞
- 區分良性或惡性
- 癌症分期與治療計畫
- 評估治療效果
- 追蹤癌症術後是否復發或轉移



鑑別能力

- 分辨腫瘤良惡性達92~100%
- High sensitivity 95%
- CT淋巴結之診斷敏感度約 67-75%，特異度約 66-73%
- 癌症分期與治療計畫



治療是否有效

PET-CT 在肺癌療效判斷中的應用

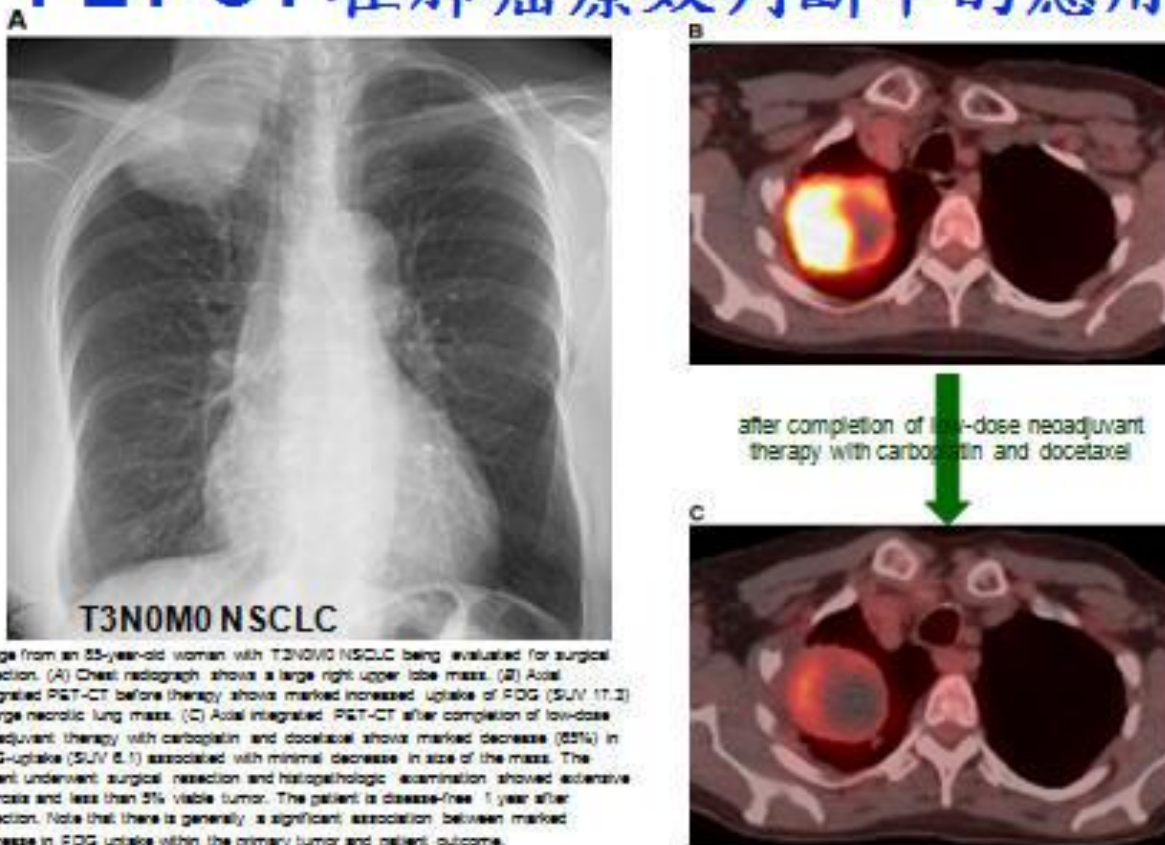


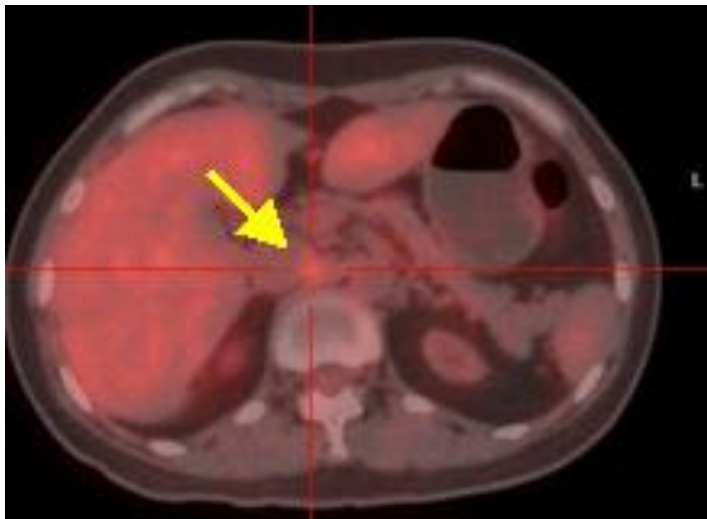
Image from an 85-year-old woman with T3N0M0 NSCLC being evaluated for surgical resection. (A) Chest radiograph shows a large right upper lobe mass. (B) Axial integrated PET-CT before therapy shows marked increased uptake of FDG (SUV 17.2) in large necrotic lung mass. (C) Axial integrated PET-CT after completion of low-dose neoadjuvant therapy with carboplatin and docetaxel shows marked decrease (65%) in FDG-uptake (SUV 6.1) associated with minimal decrease in size of the mass. The patient underwent surgical resection and histopathologic examination showed extensive necrosis and less than 5% viable tumor. The patient is disease-free 1 year after resection. Note that there is generally a significant association between marked decrease in FDG uptake within the primary tumor and patient outcome.

The Proceedings of the American Thoracic Society 6:171-179 (2009)

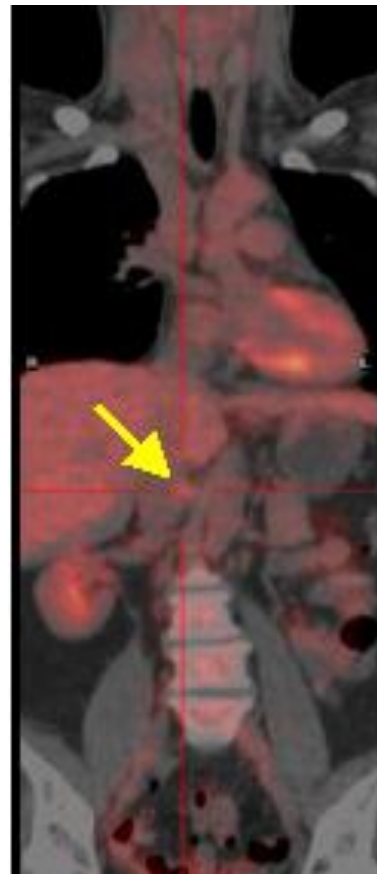


追蹤復發

- 對癌症的復發偵測有極高的靈敏度



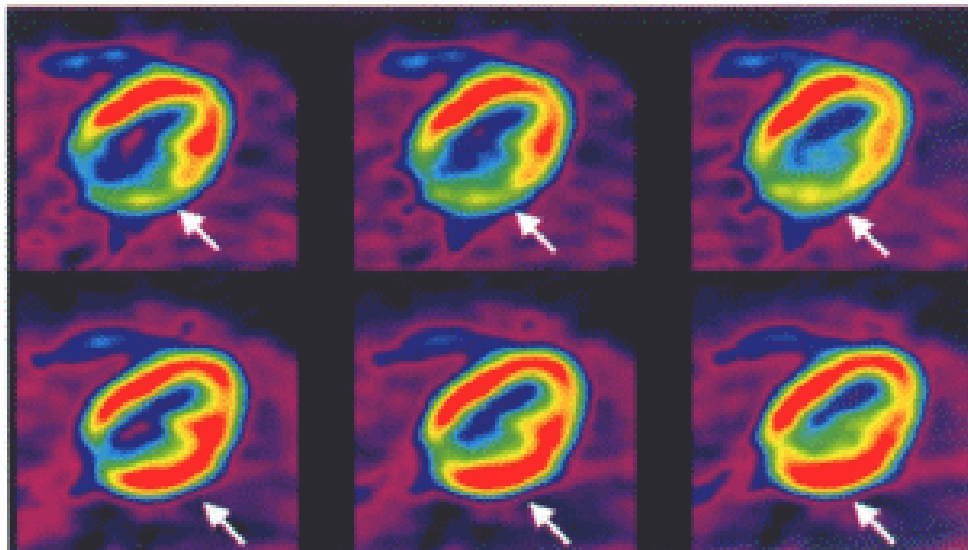
下腔靜脈後方淋巴結葡萄糖代謝增加



臨床應用

(2)心臟疾病

- 評估存活的心肌細胞
- 心肌血流檢測



PET 檢查上圖發現心循環血液供應不良
下圖發現同位置的心肌仍存活

PET V.S. SPECT

	PET	SPECT
核種	分子量小、衰變釋放正子	分子量大、衰變釋放gamma光子
核種生產方式	迴旋加速器	核反應爐
儀器	環形偵測器	一個或多個偵測器
圖片品質	解析度高(x mm)	解析度低(10x mm)
價格&健保	昂貴(三萬以上) 8種癌症有醫療保險給付，嚴格	健保給付，自費約7000
衰減修正	準確	較差



PET V.S. SPECT

PET			SPECT		
核種	半衰期	生產方式	核種	半衰期	生產方式
^{11}C	20 min	$^{12}\text{N}(\text{p}, \alpha)$ ^{11}C	$^{99\text{m}}\text{Tc}$ 腦血流檢查	6.0058 hours	$^{100}\text{Mo}(\text{p}, 2\text{n})_{99\text{m}}\text{Tc}$
^{13}N 心肌血液檢查	10 min	$^{16}\text{O}(\text{p}, \alpha)$ ^{13}N	^{123}I 神經傳導機能 檢查	13.3 hours	$^{123}\text{Xe} \rightarrow ^{123}\text{I}$
^{15}O 腦血流檢查	2 min	$^{15}\text{N}(\text{p}, \text{n})^{15}\text{O}$ $^{14}\text{N}(\text{d}, \text{n})^{15}\text{O}$			
^{18}F 腦或心臟葡萄糖代謝、腫瘤偵測	110 min	$^{18}\text{O}(\text{p}, \text{n})^{18}\text{F}$ $^{20}\text{Ne}(\text{d}, \alpha)^{18}\text{F}$			