

ENQUIRY

查詢

Positron Emission Tomography:

正電子掃描

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Education Pamphlet
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養和醫院
HONG KONG SANATORIUM & HOSPITAL



The Hong Kong Sanatorium and Hospital is the leader in cancer treatment in the region. Its Oncology Centre has the most technologically advanced equipment available and can therefore provide the best treatment.

The Positron Emission Tomography (P.E.T.) scan is one of the most effective methods for imaging and diagnosis of cancer. The availability of such new technology will have a significant impact on the future management of cancer in Hong Kong.

養

和醫院是香港癌病治療方面具領導地位的醫院。附設的腫瘤科中心，擁有最先進的醫療器材，能為病人提供最佳的服務。

養和醫院特設的正電子掃描，是當今最有效的癌症掃描及診斷方法之一。這項先進的科技，將對香港癌症治療產生深遠的影響。

WHAT IS P.E.T.?

甚麼是正電子掃描？

P.E.T. is one of the most medically advanced tools in diagnosing disease. A P.E.T. scanner is literally a camera that can produce powerful images of the human body's metabolic functions, thus revealing many of the mysteries surrounding health and disease.

Since metabolic changes occur before the functional and structural changes in the body's tissues and organs, P.E.T. facilitates the early detection of cancer and also distinguishes malignant from benign diseases.

正電子掃描是現時最先進的醫療診斷器材之一。正電子掃描器是一台能夠攝取精密影像，檢測人體新陳代謝功能及健康狀況的掃描器。

由於人體的新陳代謝每能在細胞及器官出現功能性及結構上的病變之前出現變化，因而正電子掃描能有助檢驗出早期的疾病，而且它更能分辨屬於惡性或良性的腫瘤。

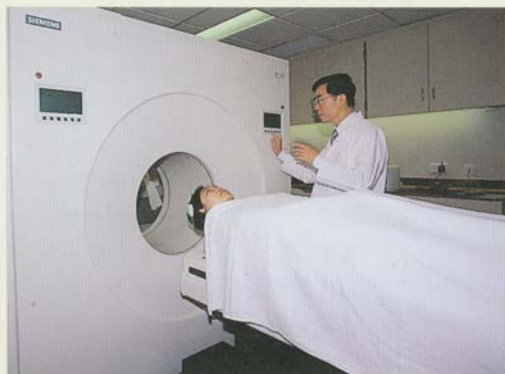


Fig 1
圖 1

Fig 1 - P.E.T. Scanner at the Hong Kong Sanatorium & Hospital-Siemens ECAT EXACT model.

圖 1 設於養和醫院內的西門子正電子掃描器。

HOW DOES P.E.T. WORK?

正電子掃描怎樣發揮功能？

Simple compounds such as glucose, amino acid, or water are labelled with positron-emitting tracers. These are then injected into the patient to serve as biological imaging probes.

After a period of thirty minutes to an hour, when these compounds have been absorbed by the tissue, the patient is scanned with the P.E.T. scanner to pick up the signals from the tracers. These signals will reveal the distribution and activity of the tracers within various parts of the body.

The scanner's computer converts these signals into metabolic images, which show the normal or diseased status of the tissues inside the body.

簡單的化合物如葡萄糖、氨基酸或水份等會連同放射正電子的同位素，一起注入病人身體作為生物影像探測器。

約三十分鐘至一小時，當注入的化合物被病人體內的細胞組織吸收後，利用正電子掃描器接收正電子同位素所發出的訊號，清楚顯現有關化合物在體內不同部分的分佈及活動情況。

掃描器內的電腦會把訊號轉化為新陳代謝影像，展示體內細胞組織的健康狀況。

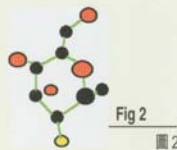


Fig 2
圖 2

Fig 2 - A biological imaging probe: 3 dimensional diagram of F-18 Fluorodeoxyglucose.

圖 2 - 生物影像探測器；氟化缺氫葡萄糖 (F-18 Fluorodeoxyglucose) 3-D 立體圖像。



Fig 3
圖 3

Fig 3 - A normal P.E.T. scan, showing the normal glucose uptake by the heart. There is no tumour in the whole body.

圖 3 - 全身並無腫瘤的正電子掃描圖像，顯示心臟正常攝取葡萄糖。

HOW CAN P.E.T. HELP CANCER PATIENTS?

正電子掃描怎樣幫助癌症病人？

How are positron imaging agents prepared?

正電子掃描藥劑是怎樣來的？



1. The most advanced medical cyclotron – capable of producing positron emitters. 用以生產正電子同位素的最先進醫療迴旋加速器。



2. Positron emitters are combined in the computerized radiochemistry synthesizer with simple compounds such as glucose to become positron imaging prescriptions.

電腦化藥劑合成器使正電子同位素跟簡單的化合物如葡萄糖等合成為正電子掃描藥劑。



3. Positron imaging prescriptions undergo strict quality control to ensure they have attained international quality standards.

正電子掃描藥劑經嚴格之品質檢定，以確保合乎國際品質水平。

Does the patient have a hidden cancer and where is it?

P.E.T. has the ability to scan the entire body of a patient to determine whether the patient has concealed cancer.

Because cancer cells are generally highly metabolically active and divide rapidly, they consume 2-10 times more glucose than normal cells. Therefore, they appear as "hot spots" in the P.E.T. scan.

病人是否患有隱藏的癌症？
哪裏患病？

正電子掃描能作全身的掃描並斷定病人是否患有隱藏的癌症。

由於癌細胞一般會快速分裂，且新陳代謝特別活躍，攝取的葡萄糖是正常細胞的二至十倍，因此在正電子掃描影像圖上會現出明顯的「熱點」。

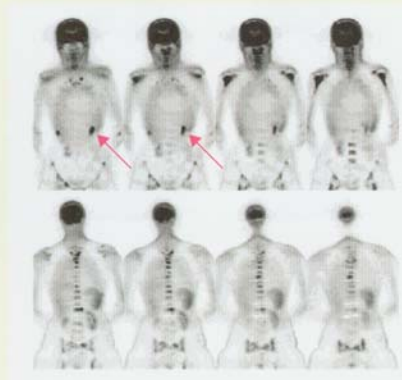


Fig 4

圖4

Fig 4 – Patient who has metastasis but with an unknown primary. P.E.T. scan found a primary stomach cancer.

圖4— 患有不明病源有轉移腫瘤的病患者。圖為利用正電子掃描發現胃癌的病源。

Is a tumour benign or malignant?

For example, about 80% of solitary pulmonary nodules are benign, but 20% are malignant. The P.E.T. scan has the ability to distinguish between malignant and benign nodules with 94% accuracy.

良性或惡性腫瘤？

比方，80%肺部小節瘤都是良性的，只有20%屬於惡性。正電子掃描能分辨出腫瘤的性質，準確程度高達94%。

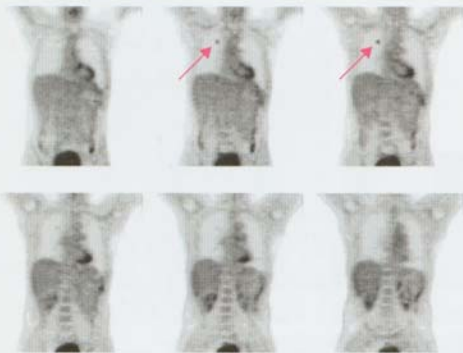


Fig 5

圖5

Fig 5 - The P.E.T. scan of a 67-year old male patient presented with a solitary pulmonary nodule in the right upper lung. Scan shows positive FDG uptake indicating that the nodule is malignant and the patient should have surgical excision.

圖5—一名67歲男病者肺部右上方出現小節瘤。正電子掃描檢測到有FDG的黑點，顯示節瘤屬於惡性，須即時進行切除手術。

Has the cancer spread? (Staging of Cancer)

Cancer that spreads to other parts of the body (metastasis) also shows an increased glucose uptake that will also be detected by the P.E.T. scan.

This method of detecting hidden tumours within the body was never available in the past.

癌細胞是否擴散？ (癌症的階段)

擴散到身體其他部份的癌細胞亦會呈現攝取較多葡萄糖的現象，同樣可由正電子掃描檢查得到。

這種能檢測全身隱藏腫瘤細胞的方法是前所未有的。

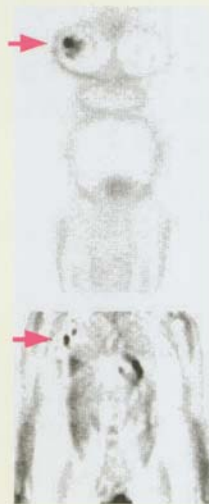


Fig 6

圖6

Fig 6 - P.E.T. scan of a patient with breast cancer. The upper picture shows the primary cancer in the right breast. The lower picture depicts two lymph nodes in the right axilla with FDG uptake indicating tumour metastasis. Both the primary and affected lymph nodes can be surgically excised.

圖6—正電子掃描下的乳癌患者。上圖：患有乳癌的右乳房。下圖：病者右邊腋窩有兩個FDG黑點，顯示有惡性腫瘤擴散到的淋巴結。兩者均可以手術切除。

What if there is a recurrence of the cancer?

Recurrence of tumour is usually difficult to detect using traditional methods. One cannot treat what one cannot see and knows exist.

P.E.T. offers a new hope for patient so that any recurrence or metastasis can be detected earlier permitting further treatment likes surgery, chemotherapy and radiotherapy, which can be reapplied at an earlier stage.

癌病有否復發？

腫瘤復發很難以傳統方法檢查，不能察覺的腫瘤，便不能及早治療。

正電子掃描能夠檢驗出復發或擴散腫瘤的新陳代謝病變，因而能及早進行治療，如採用手術、化療及放射治療等，為病者帶來新希望。



Fig 7

圖 7

Fig 7 - A 42-year old female patient who had a resection of the uterus and ovaries for ovarian cancer. Recurrence of metastatic lymph nodes can be seen in the abdomen.

圖 7 - 一位四十二歲女病者，曾經接受輸卵管卵巢切除手術割除卵巢癌。事後正電子掃描發現病者腹中有復發的淋巴結擴散黑點。

Is the cancer treatment working?

P.E.T. scan can show the effectiveness of surgery, chemotherapy and radiotherapy in the treatment of cancer. Cancer that is successfully treated will no longer be metabolically active.

治療方法是否有效？

正電子掃描同時能顯示病人正在採用的癌病治療方法，如手術、化療及放射治療等是否有效。因為當癌細胞受到控制時，患處的新陳代謝將變得不再活躍。

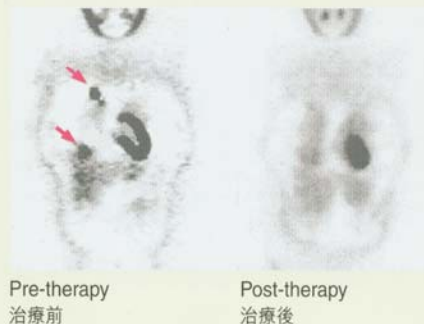


Fig 8

圖 8

Fig 8 - A patient with multiple cancer metastases in the lung. The picture on the left is taken before chemotherapy showing 3 lesions. The picture on the right is taken 10 months after chemotherapy showing successful elimination of the lesions.

圖 8 - 圖為一名於肺部有多個轉移性癌腫瘤的病者。左圖：進行化療前顯示肺部有三個腫瘤。右圖：顯示經十個月後，化療使腫瘤成功消失。

How accurate is the use of P.E.T. scan in different cancers?

正電子掃描檢測不同癌病的準確程度

	Sensitivity 敏感度	Accuracy 準確度
Lung Cancer (Diagnosis of Solitary Lung Nodule) 肺癌診斷 (肺部小節瘤)	96%	94%
Colo-rectal Cancer (Tumour Recurrence) 直腸癌 (腫瘤復發)	93%	95%
Breast Cancer (Detection of Metastasis) 乳癌 (擴散追尋)	85%	93%
Nasopharyngeal Carcinoma 頭及頸癌	88%	91%
Stomach Cancer 胃癌	90%	90%
Pancreatic Cancer (Diagnosis of Primary) 胰臟癌 (初期診斷)	95%	93%

A P.E.T. scan of the heart can be used to determine whether the patient is at the risk of heart attack by imaging the heart muscle perfusion during rest and during stress.

利用正電子掃描取得病人在鬆弛及運動狀態時的心肌灌注影像，能診斷病人是否會有突發心臟病的危險。

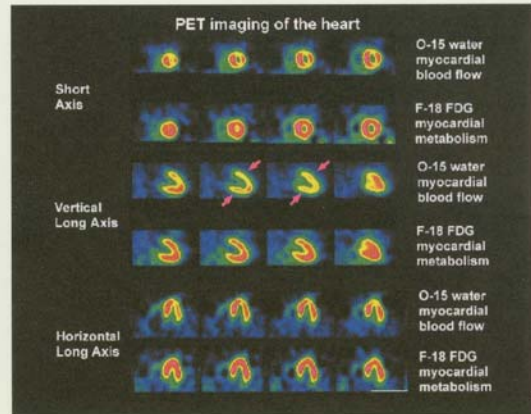


Fig 9 圖 9

Fig 9 - This patient survived a severe heart attack. Although there is decreased blood flow to the anterior wall (yellow colour in the 1st, the 2nd & the 4th row) This patient can be helped by angioplasty or coronary artery by-pass graft operation.

圖 9 - 圖中病者患有嚴重心臟病，雖然流至前心壁的血液減少 (第一、第二及第四行影像黃色部份)，顯示病者適宜接受血管成形手術或冠狀動脈心臟搭橋手術。

A P.E.T. scan is also particularly helpful in determining whether there is any salvageable damaged myocardium (hibernating myocardium). This kind of myocardium still metabolizes glucose even though it appears not to be working.

With the modern advances in cardiology, such hibernating myocardium has a very good chance of regaining function after angioplasty or coronary artery by-pass graft operation. After such successful treatment, a patient's cardiac function will show significant improvement.

另外，正電子掃描亦能有效診斷病人的心肌是否有可挽救的「冬眠心肌」。這些表面看來似是靜止不動的心肌，事實上還未有死去，並維持葡萄糖新陳代謝。

憑藉現代心臟病醫術的發展，這些冬眠心肌透過血管成形手術及冠狀動脈心臟搭橋手術而回復功能的機會相當高。成功治療後，病人的心臟功能會有明顯的改善。

Dementia

In neurology, a P.E.T. scan can show 3-dimensional images of blood flow in the brain for the diagnosis and monitoring of the progress of therapy in various neurological diseases such as Alzheimer's Dementia, Parkinson's disease and Huntingdon's chorea.

痴呆症

在精神科方面，正電子掃描能提供腦部血液流動情況的3-D立體影像，協助診斷及監察各種精神科疾病，如早老性痴呆病、帕金森病，及杭廷頓氏舞蹈病等的治療進展。

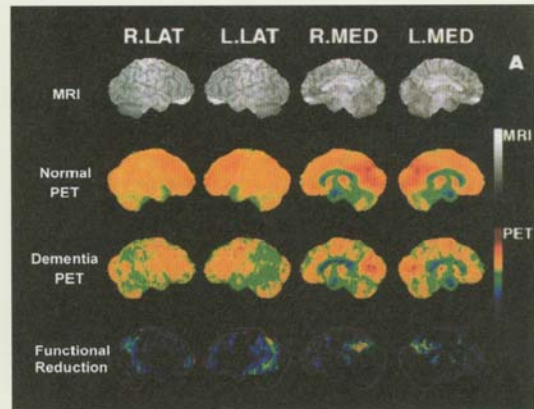


Fig 10

圖 10

Fig.10- The 1st row is a MRI image of brain. The 2nd row is the P.E.T. scan of a normal brain. The 3rd row is the P.E.T. scan of a person with dementia. Notice the image of the 4th row indicates the area that has decreased brain metabolic function.

圖 10—圖中第一行為磁力共振掃描下的腦部影像。第二行為正電子掃描下的正常腦部，第三行為正電子掃描下的痴呆症病者腦部，第四行顯示腦部新陳代謝功能減少的部分。

Epilepsy

For some types of epilepsy patients, P.E.T. scans have been found to be of value in localizing the epileptogenic focus in the brain that causes epilepsy. By utilizing modern stereotaxic neurosurgery, this can be excised and results in a permanent cure for epileptic patients.

羊癇症

對於某類羊癇症的病人，正電子掃描能夠清楚確定腦內導致羊癇症的根源部分，採用先進的腦立體測定腦科手術把羊癇症的根源切除，永久治癒。

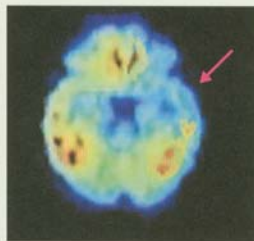


Fig 11
圖 11

Fig 11- P.E.T. scan in a patient with temporal lobe seizure shows the area of abnormally decreased metabolism in the anterior left temporal lobe between seizures (arrow). Following surgical removal of the epileptogenic focus, the patient became seizure free.

圖 11— 正電子掃描顯示一名患有羊癇症的病者，在左腦太陽身前部有降低了的新陳代謝功能（箭咀指示）。經手術切除羊癇症根源部分後，病者回復健康。

Brain Tumours

P.E.T. is a very useful tool in the management of patients with brain tumours. It can detect any recurrent brain tumour and distinguish it from fluid accumulation (oedema) after surgery or dead tissue (necrosis) after radiation treatment. It can also provide prognostic information by determining the malignancy grading of the tumour from metabolic activity prior to surgery.

Other more recent P.E.T. uses include imaging the brain blood flow reserve under stress to identify patients who are at risk from strokes and also to monitor any improvement after treatment.

腦腫瘤

正電子掃描亦是治療腦腫瘤的有效器材。它能檢測所有的復發腦腫瘤，同時可以辨別假腫瘤如手術後的水腫或放射治療後的壞死物。正電子掃描亦能透過腫瘤的新陳代謝活動，在手術之前診斷腫瘤所屬的惡性程度及展望手術成效。



Fig 12
圖 12

Fig.12- A patient with malignant brain tumour who has received radiation to the right side of his brain. CT scan on the left shows post-radiation changes. P.E.T. scan on the right shows focal area (arrow) where tumour is still not yet destroyed.

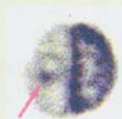


圖 12— 圖中顯示一名患有惡性腦癌病者曾接受右腦放射治療。左圖：電腦掃描影像顯示病者在放射治療後的變化。右圖：正電子掃描病源中心（箭咀指示），顯示有關腫瘤仍未完全消滅。

HOW DO I PREPARE FOR THE TEST?

WHAT HAPPENS DURING

A P.E.T. SCAN? 如何為檢查作準備？

進行正電子掃描時
會怎樣？

- An appointment has to be made by your doctor or yourself prior to the scan.
- You should fast for 4 hours prior to the scan.
- Inform us if you are pregnant or you think you might be pregnant; or if you are a nursing mother.
- You can take any prescribed medication on the day of your test unless you were instructed not to do so by your doctor.
- Let us know if you have diabetes. You should not take your anti-diabetic medication during fasting.
- Your blood glucose will be checked during the scan.
- P.E.T. compounds such as labelled glucose will be injected intravenously.
- 45 minutes after injection, you will lie on a scanning table. Then the P.E.T. scanner will scan the appropriate part of your body. The scan will take about one hour.
- You should allow 2.5 hours for the entire test.

- 請您的醫生或閣下先預約登記。
- 掃描之前應禁食四小時。
- 若您正在懷孕或懷疑自己懷孕及在哺乳期間，請於檢查前通知我們。
- 除非您的醫生指示停服，您可於檢測當日繼續服用任何配方藥物。
- 若您患糖尿病，請告知我們，禁食期間不應服用糖尿病藥物。
- 掃描期間會為您檢查血糖。
- 您需要接受正電子同位素化合物，例如已用正電子同位素標記的葡萄糖作靜脈注射。
- 注射後四十五分鐘，您需躺在掃描桌上，正電子掃描器會在您身體適當部分進行掃描，所需時間約一小時。
- 您應預備兩個半小時作整個檢查。

CONCLUSION

總結

P.E.T. is one of the most advanced medical tools for the detection and imaging of cancer, heart muscle evaluation and the examination of patients with dementia and epilepsy.

Its accuracy is 10-30% better than some conventional diagnostic methods and it has been shown that P.E.T. scans generally improve the management in 40-50% of patients.

正電子掃描是現今最先進的醫療技術之一，功能包括檢測及癌病掃描、診斷心肌性能、診斷痴呆症及羊癲症。

它比一般傳統的診斷方法準確度高 10-30%，而且根據研究資料顯示，在 40-50% 的病例中，採用正電子掃描均能有助改善病人的療程。