

Positron Emission Tomography

正電子斷層掃描



Gleneagles Hospital

HONG KONG

港怡醫院

Positron Emission Tomography (PET) 正電子斷層掃描

What is PET? PET是甚麼？

Positron Emission Tomography, also called PET or PET scan, is a diagnostic nuclear medicine technique. PET imaging is unique, which enables us to view and assess the human body from a functional and biochemical perspective, comparing normal and abnormal tissue metabolism rather than morphological changes as seen by X-ray, Computed Tomography (CT) and Magnetic Resonance Imaging (MRI). These images are based upon subatomic particles emitted from a radioactive substance administered to the patient.

PET 即「正電子斷層掃描技術」，或稱「正電子掃描」，是一種核子醫學診斷技術。PET 是獨特的方法，讓我們能夠從功能和生化層面去探視和評估人體，及比較正常和異常組織代謝；有別於以人體的形態變化作診斷的 X 光、電腦斷層掃描和磁力共振造影等技術。這些影像的原理乃基於注入病人體內的放射物質所放出之亞原子粒子。

How does PET work? PET 是如何運作的？

The most widely used radiotracer in PET imaging is fluorodeoxyglucose (FDG), labelled with F-18. FDG is glucose analogue. All cells need energy to sustain life. Most of the diseased tissues have a higher rate of glucose utilization, leading to higher FDG accumulation than healthier tissue. PET exploits this basic principle.

After absorption of these compounds, a scanner records the signals emitted by these tracers. A computer translates these signals into actual images - representing biological causes of normal organ function and failure of organ systems in disease. Affected areas stand out on the images, as regions of increased glucose (FDG) concentration (hot-spots).

最廣泛被利用的 PET 顯像追蹤劑是 F-18 氟化去氧葡萄糖 (FDG)。FDG 是葡萄糖的類似物。所有細胞都需要能量來維持生命，而大部分病變組織有較高的葡萄糖利用率，導致 FDG 積累比健康組織高。PET 就是利用這一基本原理。

這些化合物被吸收後，掃描器會記錄由這些追蹤劑所發放的信號。電腦會分析正常和患病組織的信號並轉換成實際圖像。病發的部位會透過局部累積的 FDG (陰影) 突顯出來。

PET in Cancer PET 應用於癌症

It is becoming quite evident that management of many types of cancers can be substantially influenced, when PET is incorporated into the diagnostic algorithm. This is applicable to the diagnosis, staging, re-staging, monitoring of treatment response, attempt to locate an unknown primary and detection of recurrence of many malignancies.

The disease is a biological process and functional changes precede anatomical changes. Based on the differences of biological activity, PET evaluation of tissue metabolism can detect the probable presence or absence of malignancy much earlier than anatomical changes. In addition, whole body imaging with PET examines all the organ systems in one procedure, evaluating not only primary but also metastatic disease.

PET has become an integral part in the management of lung, colorectal, head and neck, breast, esophageal and uterine cancers, lymphomas and melanomas. It is also helpful in certain types of gastric, hepatobiliary, ovarian, pancreatic and renal malignancies.

被納入醫學診斷的 PET，對於多種癌症的管理有重大影響。包括診斷、分期、再分期、療效監測、嘗試定位不明原發腫瘤和檢測多源惡性癌腫瘤復發。

癌症的生理和功能變異會先於結構變化出現。基於生理活性的差異，PET 透過分析組織新陳代謝從而檢測惡性腫瘤存在與否，遠比偵測結構變異來得早。再者，PET 透過一次掃描就能檢查全身所有器官；不僅原發腫瘤，就連異位擴散都可同時偵測。

PET 在多種癌症的管理上已經成為不可缺少的部分，例如肺癌、結直腸癌、頭頸癌、乳癌、食管癌和子宮癌、淋巴瘤和黑色素皮膚癌。它在胃癌、肝膽癌、卵巢癌、胰腺癌和腎臟惡性瘤的診斷也有顯著幫助。



PET in Heart Disease PET 應用於心臟病

PET scanning allows detection and measurement of inadequate coronary blood flow during stress in coronary artery disease. The quantitative analysis is not only helpful for early detection of coronary artery disease in high risk patients, but also to monitor the effect of therapy and risk modification.

The evaluation of myocardial viability (metabolism) is another key area. PET is the gold standard technique for assessment of myocardial viability.

In coronary artery disease, PET is used to:

- Evaluate impact of sudden chest pain on heart metabolism and function (stunning).
- Determine the patients most suitable for revascularization (presence of hibernating myocardium).
- Patients with hibernating myocardium have very good chance of functional recovery, after coronary artery bypass graft operation.

(PET is not a substitute for Coronary Angiography neither it can be used as a routine screening test.)

PET 可以檢測冠心病患者的冠狀動脈供血不足的情況。定量分析不僅有利於高危患者及早發現冠狀動脈疾病，亦有利於監察治療和風險調整。

心肌存活性（新陳代謝）評估是另一個關鍵功能。PET 是心肌存活性評估的黃金標準技術。

對於冠狀動脈心臟病，PET 用於：

- 評估突發性胸痛對心臟代謝及功能的重要性（心肌頓抑的情況）。
- 確定最適合患者的血運重建術（心肌冬眠的情況）。
- 冬眠心肌的患者接受「冠狀動脈旁路移植手術」後心肌功能恢復機會很高。

（PET 不是冠狀動脈造影的替代品，亦不可以用作常規檢查。）

PET in Neurology PET 應用於神經病學

- Differentiating radiation necrosis from tumour recurrence, in post-therapy cases.
- Pre-surgical localisation of epileptic focus.
- Early diagnosis of Alzheimer’s dementia and differentiating it from other types of dementia. Early and accurate diagnosis is prerequisite of successful therapy, with improved quality of life.
- 於放射治療後，鑑別術後放射性組織壞死與腫瘤復發的情況。
- 術前定位腦部癲癇區點。

■ 早期診斷阿爾茨海默氏症癡呆和鑑別其他類型的癡呆症。準確的早期診斷是成功治療、提高生活品質的先決條件。

Free Shuttle Service 免費專車服務

Gleneagles Hospital Hong Kong provides free shuttle bus service between MTR Wong Chuk Hang Station (Exit A) and the hospital (main entrance). 港怡醫院為市民提供免費專車服務往來港鐵黃竹坑站（A出口）及醫院（正門）。

Free Shuttle Schedule 免費專車服務時間表

MTR 港鐵

Gleneagles is within walking distance from MTR Ocean Park Station (Exit C). 您可由港鐵海洋公園站（C出口）步行至港怡醫院。



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Limitations of PET
PET 的局限性

| A negative FDG PET scan does not necessarily rule out presence of malignancy. A few tumour types depend upon protein metabolism rather than glucose. In such cases FDG PET scan can be a false negative.

| PET can underestimate the severity of disease, if blood sugar is too high.

| PET should not be used alone as a diagnostic tool. Its value is enhanced when it is part of a larger diagnostic work-up.

| 陰性的 FDG PET 掃描並不一定能夠排除惡性腫瘤的存在。少量腫瘤類型依賴蛋白質代謝，而不是葡萄糖。在這種情況下 FDG PET 掃描可能呈現假陰性。

| 如果病人血糖過高，PET 可能低估其病情。

| 診斷過程中，PET 不應單獨使用；只有配合其他檢查數據，其醫療價值才能充分發揮。

PET in Infection and Inflammation
PET 應用於鑑別感染和炎症

Besides malignancy, FDG PET can also help localise the source of fever of undetermined origin. In the musculoskeletal system, FDG PET accurately helps diagnose spinal osteomyelitis, and in inflammatory conditions such as sarcoidosis and vasculitis, defining the extent of disease and monitoring response to treatment. FDG PET may also be used in differentiating infections from other complications such as loosening in patients with painful joint prosthesis.

除了惡性腫瘤，FDG PET 還可用於找出不明發燒的源頭。在骨科方面，FDG PET 幫助準確地診斷脊柱骨髓炎，而對於炎症像脊柱結節病和血管炎，也可判定病程和監測治療進度。FDG PET 也可用於鑑別感染和其他併發症，如病人置換關節後出現的假體關節鬆脫和疼痛。

Preparation
掃描前的準備

Please be punctual. If you need to reschedule, notification must be given 48 hours in advance. This is because the radioactive tracer is expensive and is produced according to number of scheduled patients.

請大家準時到達。如果您需要更改預約，必須於四十八小時前提出。因為放射性追蹤劑是依據病人的數目而訂製，而且價格高昂。

Diet 飲食

For a better diagnostic PET examination, it is crucial that there is minimal physiological artifactual uptake by the organs of the FDG injection. Please ensure:

| Fasting of food for 6 hours is required. Please be well hydrated and drink plain water.

| No gum chewing.

| No smoking on the scan day.

| No change in your medication is required.

If you are diabetic, please inform our staff.

為了獲得更好的診斷效果，必須有效減低正常細胞吸收葡萄糖注射液。請確保：

| 禁食至少 6 小時。請攝取充足水分，可喝白開水。

| 不可咀嚼香口膠。

| 掃描當日禁止吸煙。

| 照常服用您的藥物。

如果您是糖尿病患者，請告知職員。

Medical History 病歷

For accurate correlation with other examinations: Kindly bring along all your previous x-ray, ultrasound, CT or MRI films and any blood test reports.

為與其他檢查準確對照：

請帶備您過往的 X 光、超聲波、CT 或 MRI 舊片和任何驗血報告。

Attire 服裝

| Wear comfortable clothing.

| Leave jewelry at home.

| You will be asked to change into a hospital gown prior to the start of the examination.

| 穿着舒適的衣服。

| 把首飾留在家裡。

| 檢查開始前，您須要換上掃描服。

Activities 活動

Please refrain from strenuous exercise 48 hours before the examination in order to avoid high tracer uptake in skeletal muscle.

掃描前四十八小時避免劇烈運動以防追蹤劑積累在骨骼肌。

Length of Examination 檢查時間

| The total examination time is expected to last about 2 to 3 hours. You would therefore have to be prepared that you will be in the department this length of time.

| For certain patients, another set of images maybe necessary depending on type of malignancy or better diagnostic decisions. Total procedure time may be longer and can exceed 4 hours. Unfortunately, this will only be known after the initial images are obtained. You will be informed accordingly.

| Some of the diabetic patients are expected to spend longer time in the department.

| 檢查時間預計需時約兩至三小時。病人必須做好在部門長時間逗留的準備。

| 某些病人可能需要加照影像，取決於腫瘤類型，或是為了獲得更好的診斷效果，整體時間可能會較長，甚或超過四小時。請諒解我們無法預先通知您加照的安排，只可在獲得初步影像後才能確定。我們會盡快通知您相關安排。

| 某些嚴重的糖尿病患者預計將在部門逗留較長時間。

On the Day of the Examination
檢查當天的過程

Before the Examination 掃描前

| Our staff will take your medical history.

| You will need to change a hospital gown. An intravenous line will be set-up. You will feel a slight pinprick.

| Your blood glucose level will be checked to ensure that it is at a correct level.

| You will be given a small amount of the radioactive tracer labelled glucose (FDG) via an intravenous administration into a peripheral vein.

| After its administration, it takes about 45 to 60 minutes for the radiotracer to travel through your body and be absorbed by the organ or tissue to be imaged. In the meantime, you will rest quietly and avoid movement or talking, as this may alter the distribution of the substance. You will not be able to feel the radioactive substance in your body.

| After the appropriate time, a nurse or radiographer takes you into a special examination room that houses the PET scanner.

| The scan time is approximately 20 minutes. After the initial scan, the data will be processed and checked. In certain cases, physician may require a delayed scan. The second scan will not require any additional preparation.

| 護理人員會向您索取您的病歷。

| 您須要更換掃描袍及設置靜脈注射造口。過程會感到輕微的針刺痛。

| 我們將檢查您的血糖水平，以確保在正常範圍。

| 微量放射性的追蹤劑 (FDG) 將通過靜脈注入您的體內。

| 注射後，追蹤劑會經血液循環運行全身，約需時四十五至六十分鐘讓器官或組織吸收以進行掃描。在此期間，您需要安靜地休息，避免活動和說話，以免影響吸收及令影像質素下降。您將不會感覺到體內的放射性物質。

| 在適當時間，護士或放射技師將帶領您到 PET 掃描室進行檢查。

| 掃描時間約二十分鐘。初步掃描後的影像數據將被檢視。在某些情況下，醫生可能會要求您加照掃描。加照掃描將不需要任何額外的準備。

After the examination 完成檢查後

| You should feel fine. There are no side effects from the injected radiopharmaceutical.

| You may resume your normal diet following the procedure.

| You should drink additional fluids for several hours after the scan.

| There are no physical restrictions after the procedure.

| The scan results will then be sent to your doctor.

| 您應該感覺如常。放射性藥物是沒有副作用的。

| 您可以恢復正常飲食。

| 掃描結束後幾個小時，您應該多喝水或飲料。

| 掃描後沒有活動限制。

| 掃描結果將送交您的主診醫生。

Benefits and Risks
好處和風險

Benefits 好處

| PET is a functional and metabolic imaging technique. It can detect biochemical alterations to suggest disease presence, much earlier than anatomical changes detectable by anatomical imaging methodologies as CT or MRI.

| With well-planned integration of PET into diagnostic and treatment plans of primary and recurrent malignancies, the numbers of unnecessary diagnostic and surgical interventions are expected to reduce. The diagnostic and surgical procedures with no additional benefits on the morbidity and mortality could be spared, saving cost and unnecessary trauma.

| The most commonly used radiopharmaceutical (FDG) is radiolabeled glucose (sugar). Glucose is present in our bodies and is necessary for energy requirements. It is short-lived and is injected in minute quantity delivering less radiation exposure. It does not affect the normal body functions.

| PET 是一種針對身體組織代謝和功能的造影技術。它可透過檢測生化改變顯示病症，遠早於偵測結構變異的造影技術如 CT 或 MRI 等。

| 以 PET 配合原發性和復發性腫瘤的診斷和治療，可減少不必要的診斷和手術。雖對發病率和死亡率沒有正面影響，PET 可節省醫療成本和減少不必要的創傷。

| PET 最常用的放射追蹤劑 (FDG) 是帶有微量輻射的葡萄糖。葡萄糖是我們身體原有物質，也是必需的能量來源。造影過程只需注射少量追蹤劑，而其輻射衰減速度快，並不會影響身體的正常功能。

Risks 風險

| Although a radioactive substance is used during a PET scan, the amount of radiation that you are exposed to is low. The amount of radiation in a radiotracer dose isn't enough to affect the normal processes of your body.

| However, the radiotracer may expose radiation to the fetus of a pregnant woman or to the infant woman who is breast-feeding. You and your doctor can discuss risk to the fetus or infant versus the reasoning and benefit of having a PET scan performed. Please inform our staff if you are, or think you might be pregnant.

| PET 掃描過程中會注射放射性物質，但您接觸到的放射劑量其實很低。追蹤劑的放射劑量不足以影響您身體的正常功能。

| 追蹤劑或會令胎兒或授乳中的女士受輻射影響。您可與您的醫生商討 PET 掃描對胎兒或嬰兒的好處和風險。如果您正在懷孕或可能懷孕，請告知我們的職員。

