



## 疾病診療期程

疾病  
Disease

疾病發生前

疾病發生後

症狀  
Symptom

無症狀

無/輕微症狀

中症

重症

死亡



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疾病發生前

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無/輕微症狀

中重症

症狀緩解/消除

處置  
Management

定期檢查

治療前

治療過程

治療後追蹤

如何有效提早治療？

如何有效準確治療？

如何有效確認治療效果？

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## 本週學習目標

### 1. 認識醫學影像於診斷的價值 (定期檢查、治療前)

透過影像技術早期發現疾病  
不同種類影像的適應症與優勢  
影像人工智能輔助診斷

### 2. 了解醫學影像於治療的應用 (治療過程、治療後追蹤)

介入性放射學、手術導航、放射治療規劃與影像監測  
透過影像追蹤治療效果  
疾病預後評估的可能性

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# 醫學影像診斷應用

定期檢查、治療前價值

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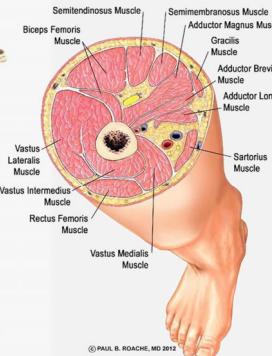


## 從三維人體結構到醫學影像

### 人體構造 (3D)



### 結構剖面示意圖



### 切片斷層影像



### 投射式影像



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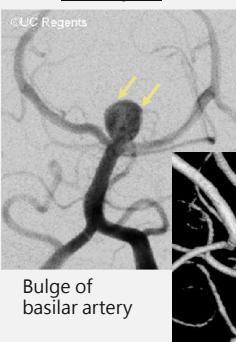
## 疾病產生之影像變化(1/3) - 型態改變



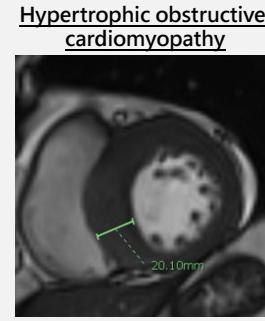
### Morphological Changes



Narrowing of internal carotid artery



Bulge of basilar artery



Increased thickness of basal posterior ventricular septum

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Journal of Cardiovascular Magnetic Resonance. 2023; 16:25(1):70.

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## 疾病產生之影像變化(2/3) - 數值改變



### Signal/Intensity Changes

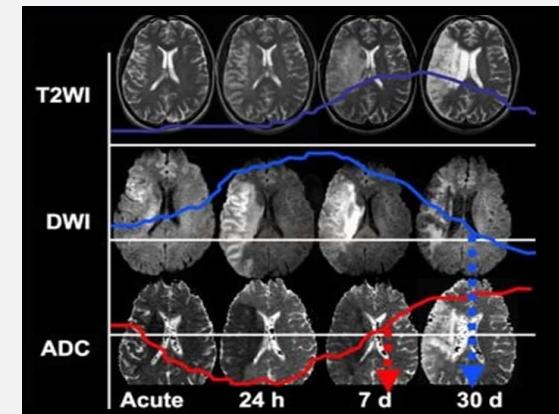
#### Ischemic Stroke

**Acute:** Ischemia → cytotoxic edema (intact BBB) → restricted extracellular space

**Subacute:** vasogenic edema (disrupted BBB)

**Chronic:** tissue death

- Hyperintense
- Isointense
- Hypointense



<https://www.stroke-manual.com/mri-dwi-in-stroke-diagnosis/>

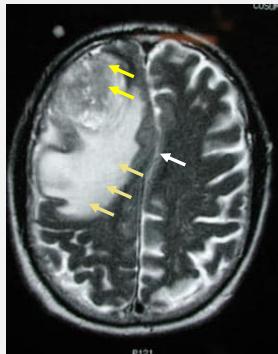
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## 疾病產生之影像變化(3/3) - 混合改變



### Combined Changes

Glioblastoma



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Subdural Hematoma



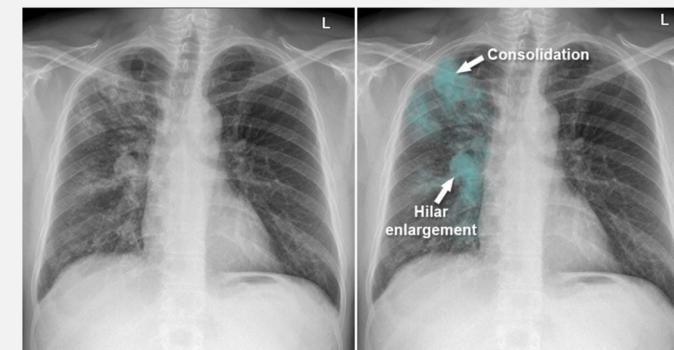
[https://www.lumen.luc.edu/lumen/meded/radio/curriculum/neurology/ic\\_hemorrhage\\_2013.htm](https://www.lumen.luc.edu/lumen/meded/radio/curriculum/neurology/ic_hemorrhage_2013.htm)

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## 健康檢查與傳染病防治



### Primary Pulmonary Tuberculosis (TB)



Consolidation refers to a region of lung tissue that has become solid due to the filling of alveoli with fluid, pus, blood, or inflammatory cells.

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[https://www.radiologymasterclass.co.uk/gallery/chest/pulmonary-disease/tuberculosis\\_tb](https://www.radiologymasterclass.co.uk/gallery/chest/pulmonary-disease/tuberculosis_tb)

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透過影像技術早期發現疾病

## 肺癌篩檢的效益



The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 AUGUST 4, 2011 VOL. 365 NO. 5  
Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening  
The National Lung Screening Trial Research Team\*

Reduction of 20.0% in mortality from lung cancer compared with the radiography group.



### 肺癌篩檢推動一週年，符合資格的您做了嗎？

肺癌是全球癌症死因首位，我國111年肺癌標準化死亡率為每十萬人21.8人，高居臺灣癌症死因第一位。肺癌之所以死亡率較高，源自於其早期病徵並不明顯，在臺灣，有一半的個案發現就醫時已經是第4期，且5年存活率僅剩約1成。若能早期發現，5年存活率可達9成以上。

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透過影像技術早期發現疾病

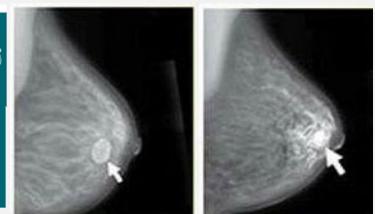
## 乳癌篩檢的效益



Swedish Two-County Trial: Impact of Mammographic Screening on Breast Cancer Mortality during 3 Decades<sup>1</sup>  
Volume 260: Number 3—September 2011

Significant reduction in breast cancer mortality (relative risk = 0.69).

Radiology



Benign cyst      Cancer



衛生福利部  
Ministry of Health and Welfare  
促進全民健康與福祉

### 每年逾萬人罹患乳癌，請定期乳房X光攝影檢查

45歲以上至未滿70歲女性，或是40歲以上至未滿45歲具乳癌家族史的女性，均可接受政府補助的2年1次乳房X光攝影檢查。定期篩檢可以降低41%的乳癌死亡風險，並減少30%的晚期乳癌發生率。

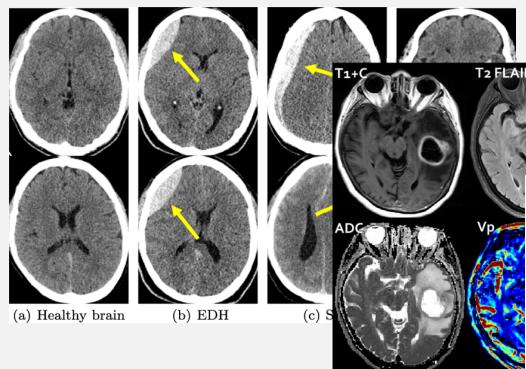
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## 各種影像的適應症與優勢



CT偵測顱內出血

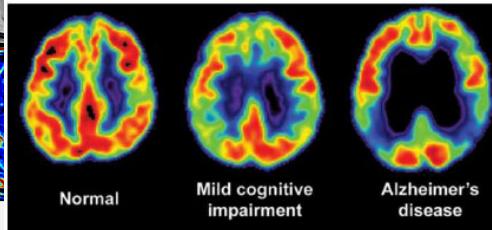


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MRI診斷腦瘤



PET早期診斷阿茲海默症



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## 各種影像的適應症與優勢



### 影像技術

### 優點

### 缺點

### 適應症

電腦斷層掃描  
Computed Tomography, CT

- ✓ 掃描速度快
- ✓ 解析度高，適用骨骼與肺部病變偵測
- ✓ 適用於導引穿刺與介入治療

- ✗ 游離輻射劑量
- ✗ 軟組織對比度較差

- ◆ 急診腦出血、創傷、主動脈剝離、腹部急症
- ◆ 肺部病變
- ◆ 骨折與關節病變
- ◆ 心血管評估

磁振造影  
Magnetic Resonance Imaging, MRI

- ✓ 軟組織對比度優異，適合神經與肌肉系統
- ✓ 無輻射適合長期追蹤
- ✓ 可提供功能性影像

- ✗ 掃描時間長
- ✗ 機台費用較高
- ✗ 高磁場禁忌症
- ✗ 幽閉空間恐懼症

- ◆ 神經系統病變
- ◆ 軟組織腫瘤
- ◆ 關節與脊椎病變
- ◆ 心肌梗塞、心肌炎

正子斷層掃描  
Positron Emission Tomography, PET

- ✓ 搭配核醫藥物偵測代謝活性
- ✓ 適用於癌症早期偵測、分期與治療評估
- ✓ 可與 CT 或 MRI 結合 (PET-CT、PET-MRI)

- ✗ 輻射暴露高於 CT
- ✗ 掃描時間長
- ✗ 解析度較低，對太小病灶可能較不敏感

- ◆ 癌症偵測與分期
- ◆ 神經退化性疾病 (阿茲海默症、帕金森氏症)
- ◆ 心臟灌注評估

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## 影像人工智能輔助診斷

### 輔助診斷肺結節

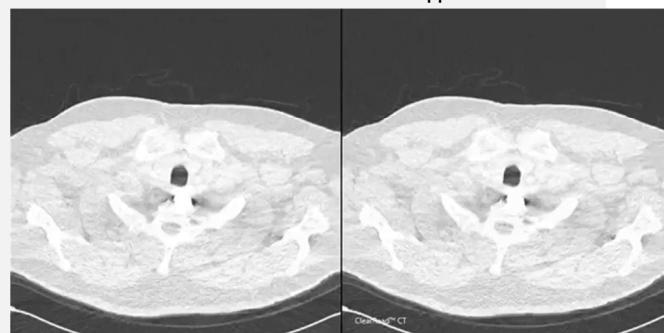


Riverain™  
TECHNOLOGIES

ClearRead CT  
Clinical AI

ClearRead CT is Riverain's transformative, concurrent read AI product built off of the patent pending ClearRead CT | Vessel Suppress software. ClearRead CT provides a vessel suppressed CT series while automatically detecting and measuring critical properties of solid, sub-solid and ground glass nodules.

FDA approved for nodule detection, 2016



<https://youtu.be/e4KUmPUUIh>

Chia-Feng Lu, <http://cfclu.lab.nycu.edu.tw>

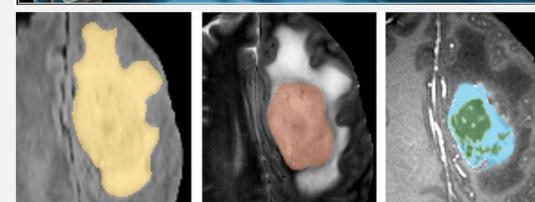
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## 影像人工智能輔助診斷

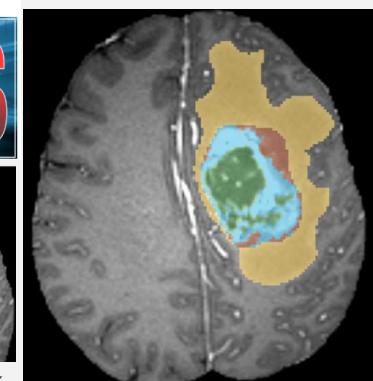
### 輔助腫瘤區域分割



Multimodal Brain Tumor Segmentation Challenge 2018



The Multimodal Brain Tumor Image Segmentation Benchmark (BRATS)



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# 醫學影像治療應用

治療導引、治療後追蹤

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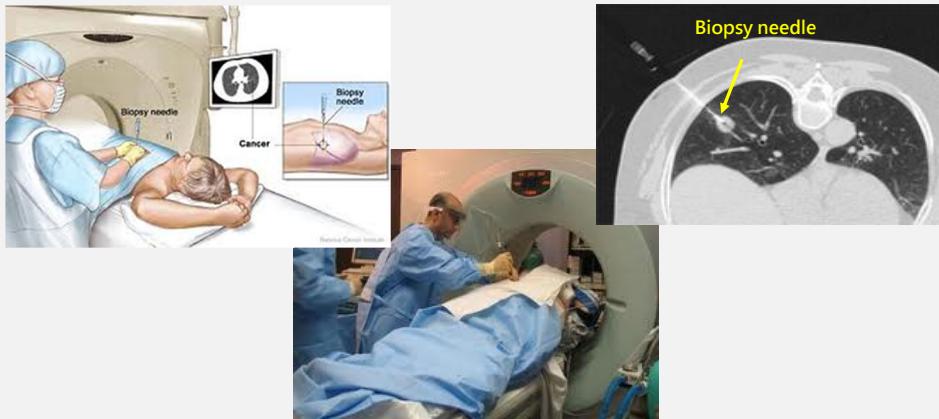
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治療過程中的應用

## 影像導引組織切片&手術導航



### CT-guided lung cancer biopsy



Chia-Feng Lu, <http://cfliu.lab.nycu.edu.tw> <https://www.hemonc101.com/what-is-image-guided-biopsy-s/1868.htm>

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治療過程中的應用

## 介入性醫學影像 - 導管支架/電燒



### Stenting of Carotid Artery



<https://youtu.be/l6mgmXGrn2U?feature=shared>

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<https://youtu.be/VVQlbj2Pj0w?feature=shared>  
[https://youtu.be/0o8DIC1n6\\_M?feature=shared](https://youtu.be/0o8DIC1n6_M?feature=shared)

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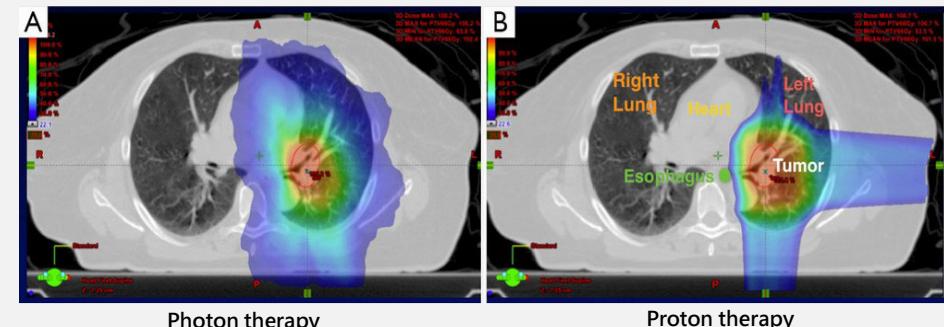
治療過程中的應用

## 放射治療計畫制定



### Treatment planning for radiation therapy

Maximizing delivered dose to the tumor while minimizing dose for the critical organ.

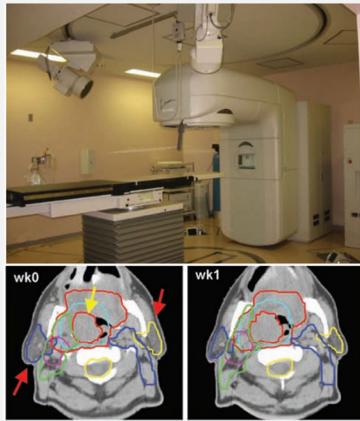
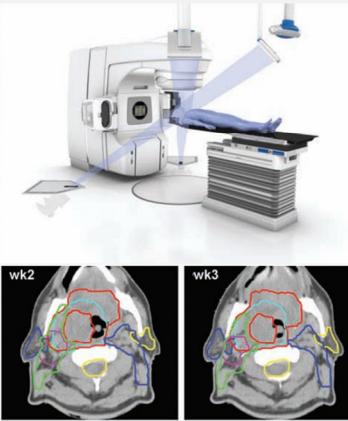


Translational Cancer Research, 4(4):E3-15, 2015.

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## 影像導引放射治療

### Image-guided Radiation Therapy (IGRT)

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An introduction to medical physics. 2017:131-73.

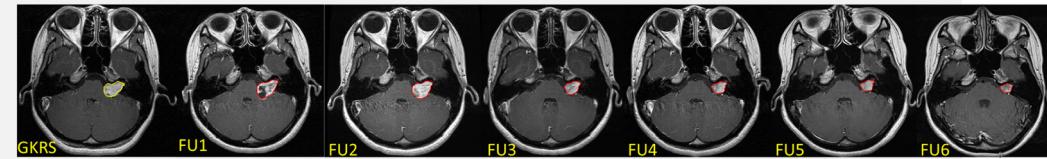
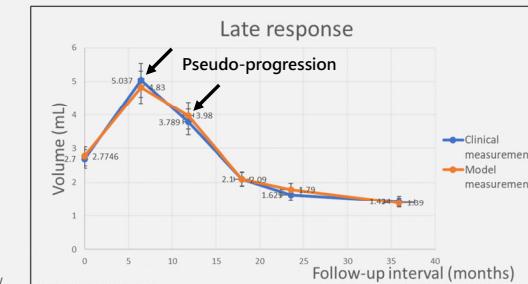


NBA

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## 影像長期追蹤治療效果

### Vestibular Schwannoma with Gamma Knife Radiosurgery

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NBA

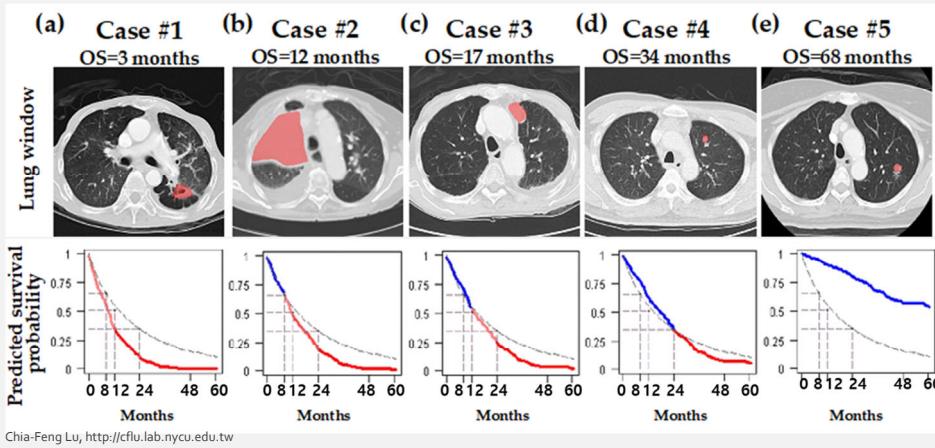
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## 疾病預後評估的可能性



NBA

### DeepSurv Personalized Survival Prediction



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## 重點回顧

- 透過適當影像技術能早期發現疾病、早期治療
- 不同種類影像有其適應症與優勢，使用正確工具才能有效輔助臨床診療
- 治療過程中，可透過影像導引鎖定病灶位置
- 放射治療前可用影像進行劑量規劃、治療過程中可以影像即時確認目標位置、調整治療區域
- 非侵入式的醫學影像可於治療後進行長期追蹤
- 影像人工智能可進一步輔助診斷、預測預後



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