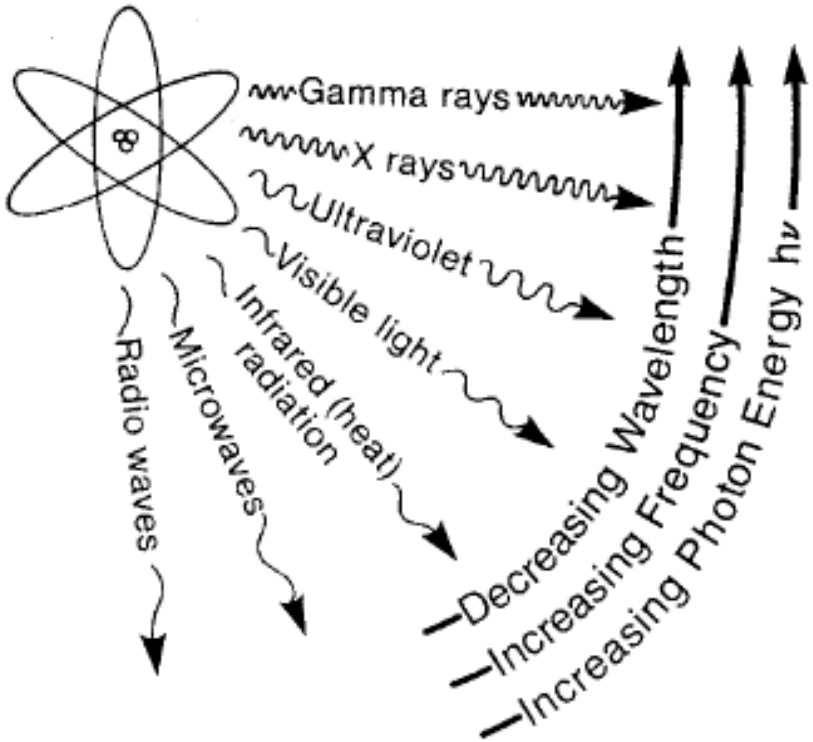
肝癌的治療方法

- 手術治療
  - 腫瘤切除 [Resection]
  - 肝移植 [Liver transplantation]
- 高頻燒灼術 [Radiofrequency ablation]
- 經皮穿肝酒精注射療法 [Percutaneous ethanol injection]

- 經動脈 (化療) 栓塞 [Trans-arterial (chemo) Embolization, TAE/TACE]
- 全身性治療
  - 化學治療 (Chemotherapy)
  - 標把治療 (Target therapy)
- 放射線治療 [Radiotherapy]

什麼是放射線？

電磁波

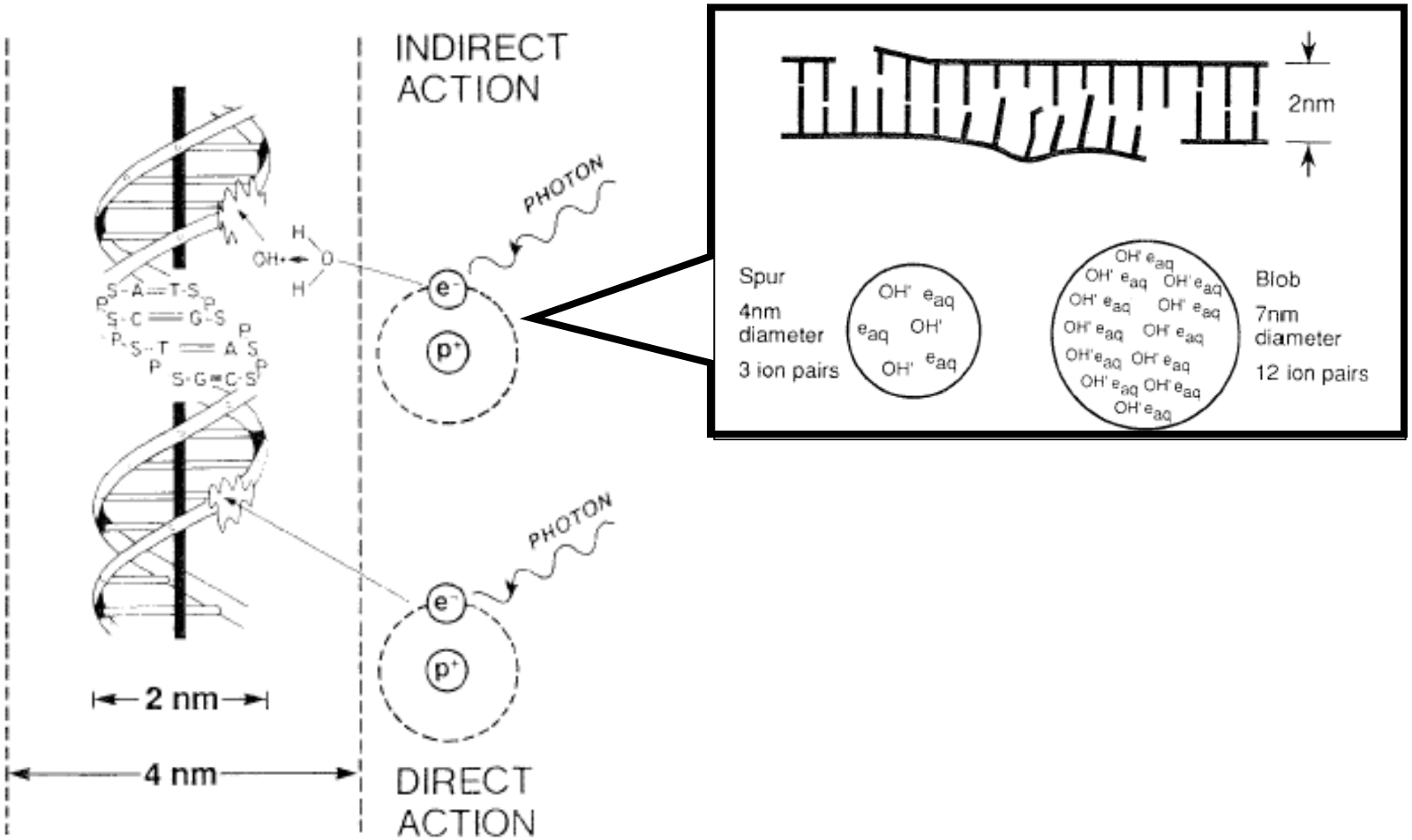

Gamma rays
X rays
Ultraviolet
Visible light
Infrared (heat) radiation
Microwaves
Radio waves
Decreasing Wavelength
Increasing Frequency
Increasing Photon Energy hν

游離輻射

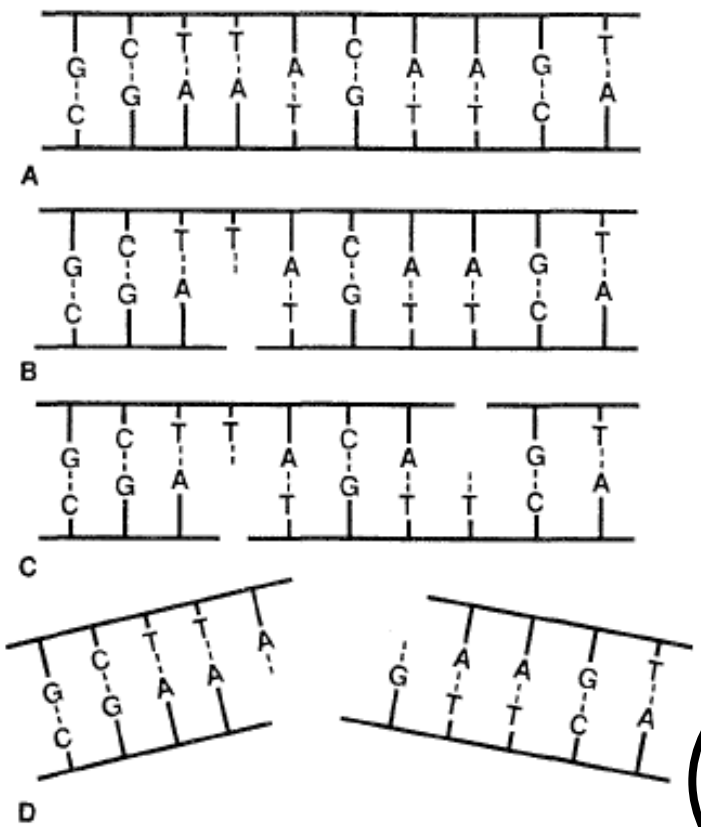
- 電磁波
  - X光（直線加速器）
  - Gamma rays （放射性同位素）

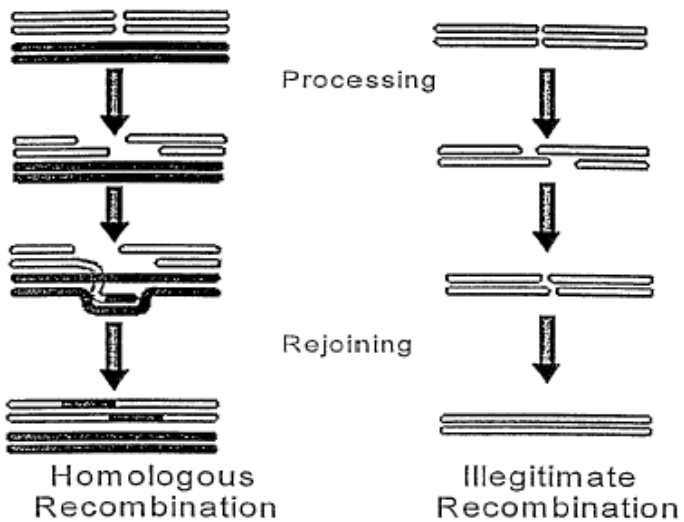
- 粒子射線
  - 電子
  - 重粒子（α粒子、β粒子、質子、中子……）

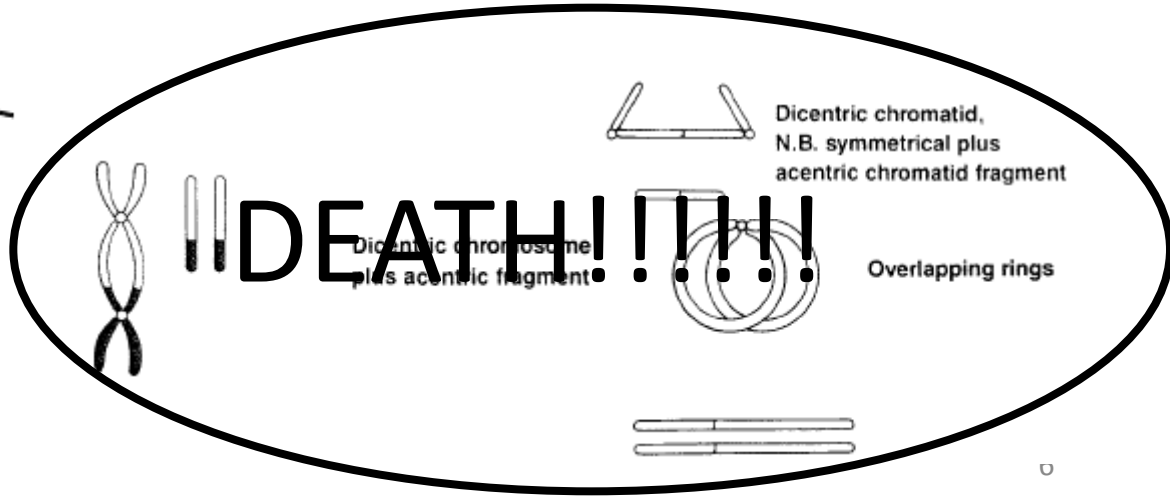
為何放射線可以殺死癌細胞？
DNA是被攻擊的目標



DNA的修復能力是關鍵

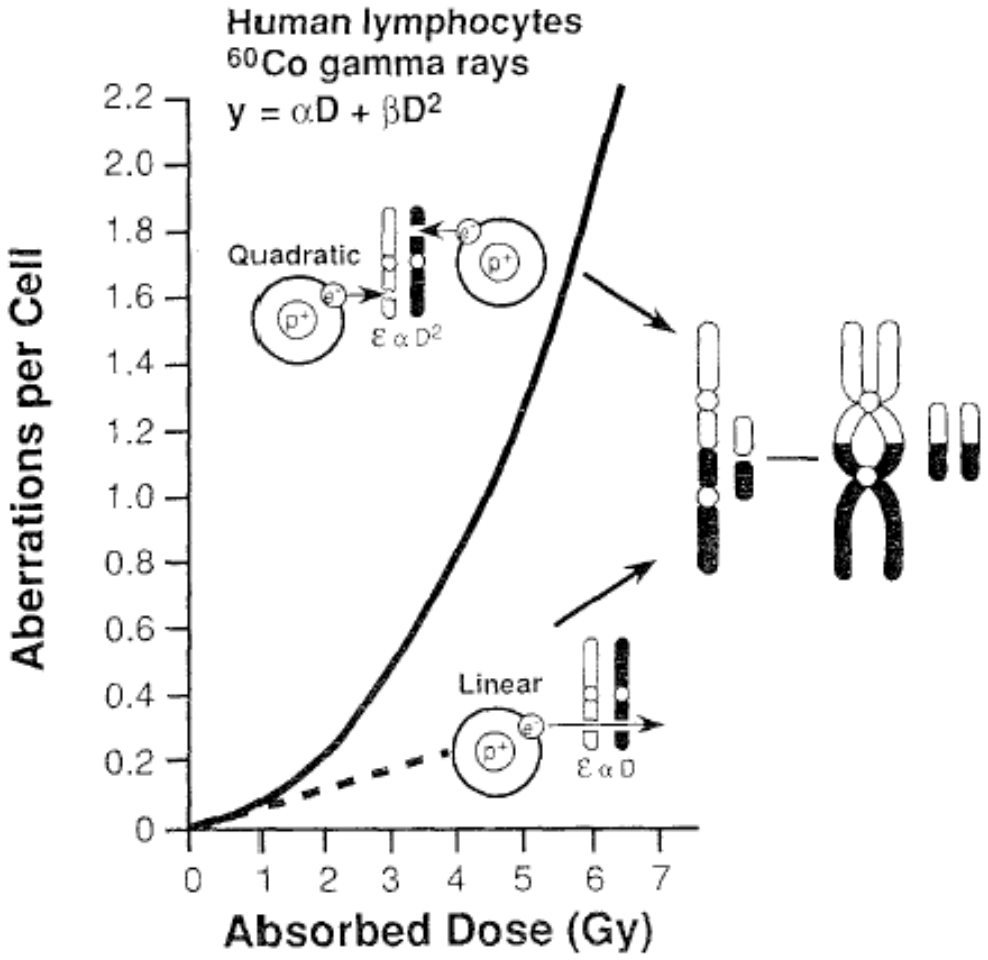






DEATH!!!!!

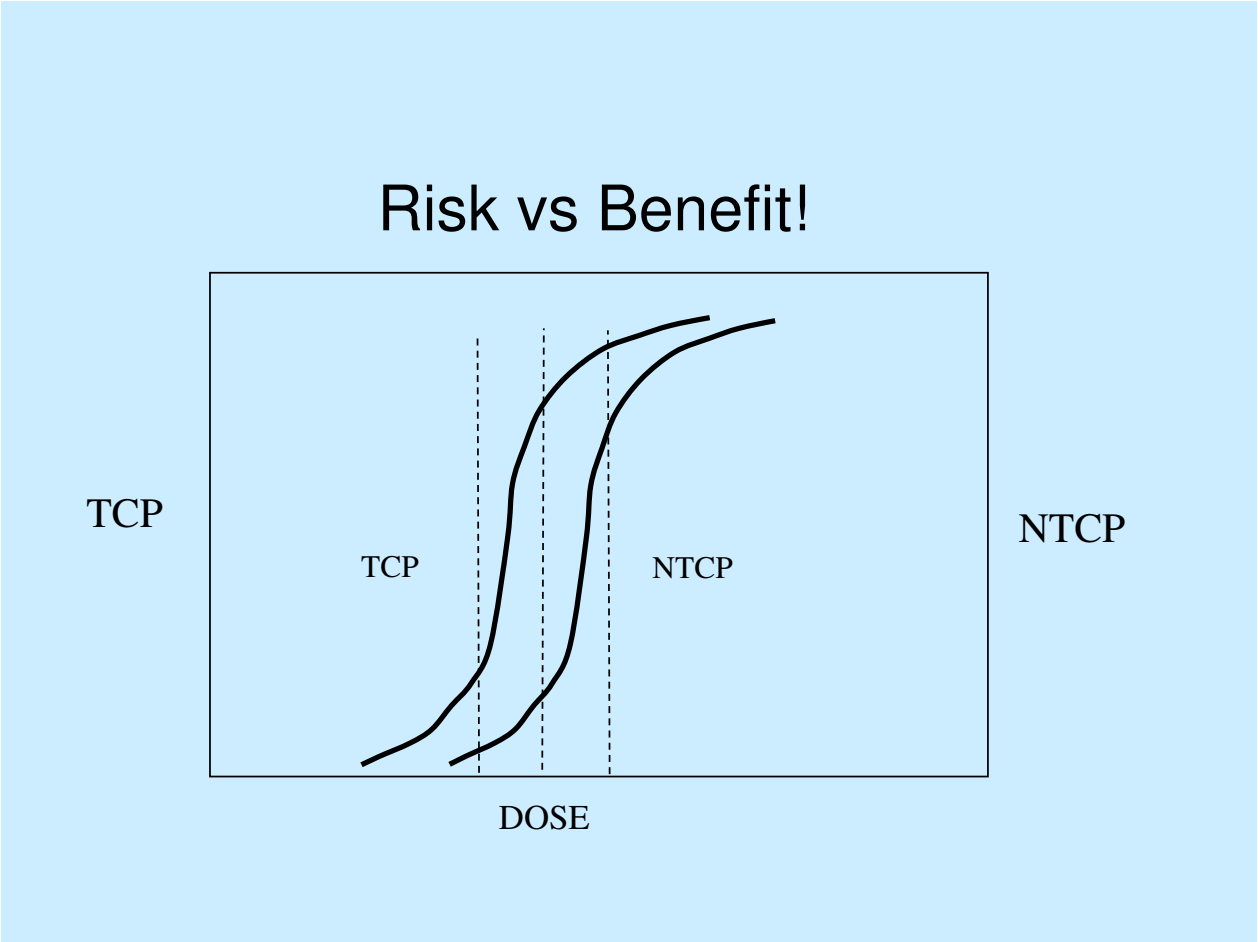
吸收劑量越高，發生染色體變異的機會越大



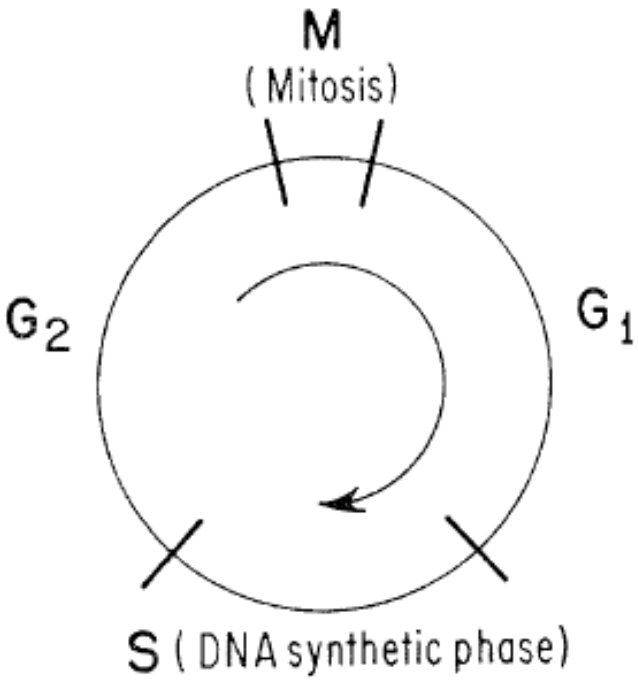
那，為何不一次把劑量統統給完？

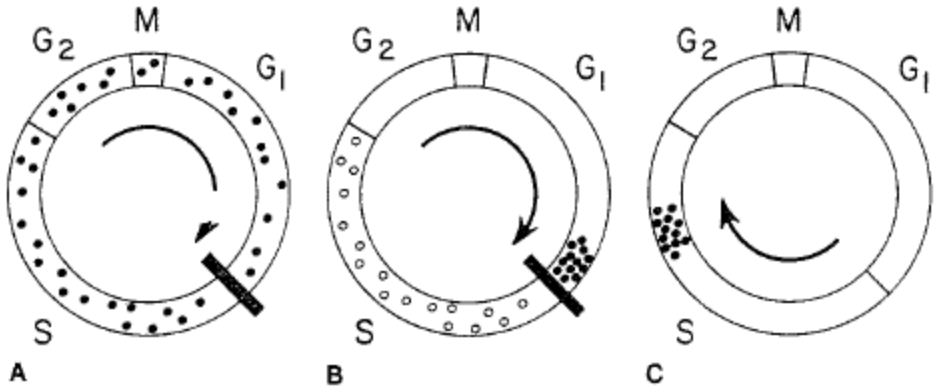
Fractionation (分次治療)

1. 要保護正常細胞 (Rapair of sublethal damage & Repopulation)



2. 細胞週期再分佈 (Reassortment of cells within the cell cycle)

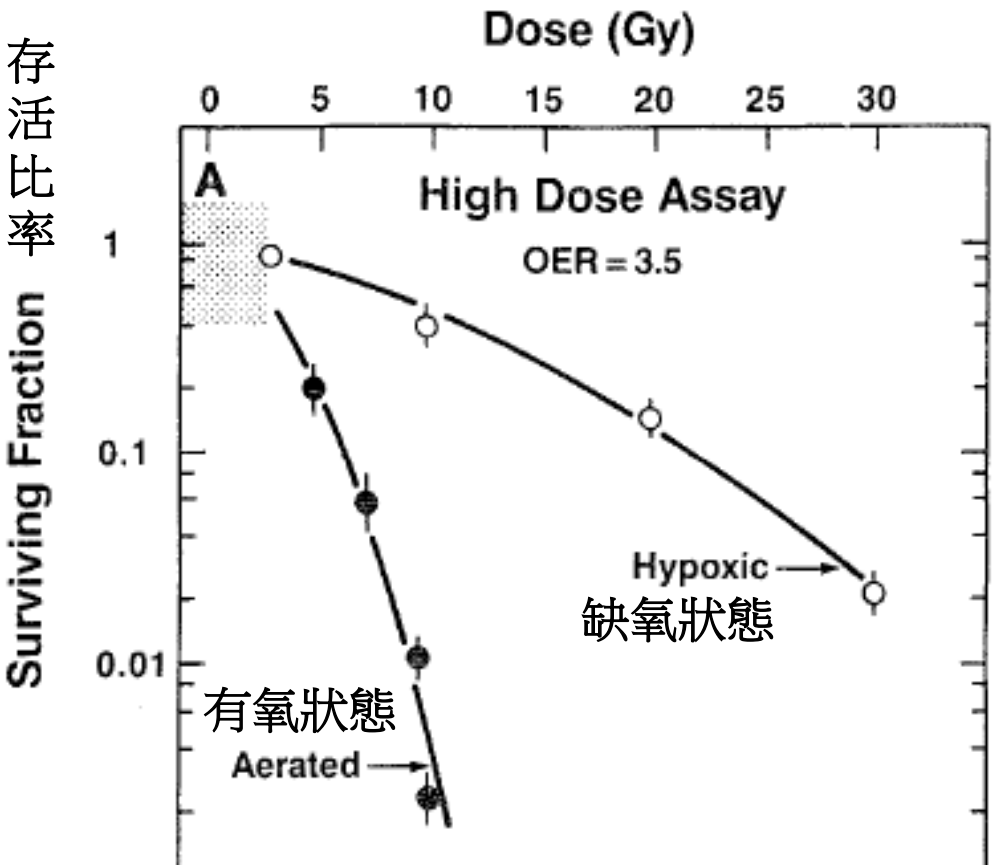


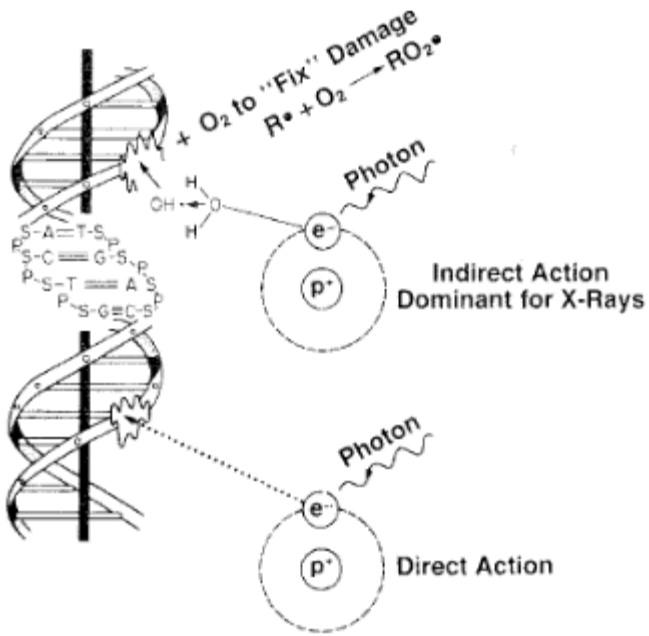


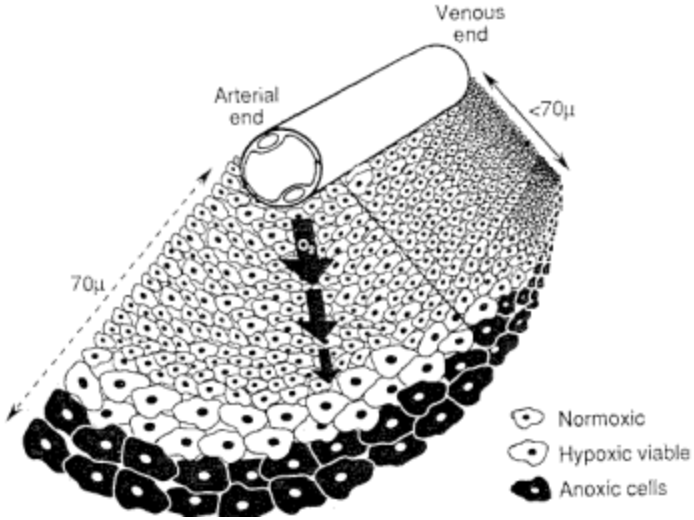
對放射線敏感： G2, M (細胞分裂期)

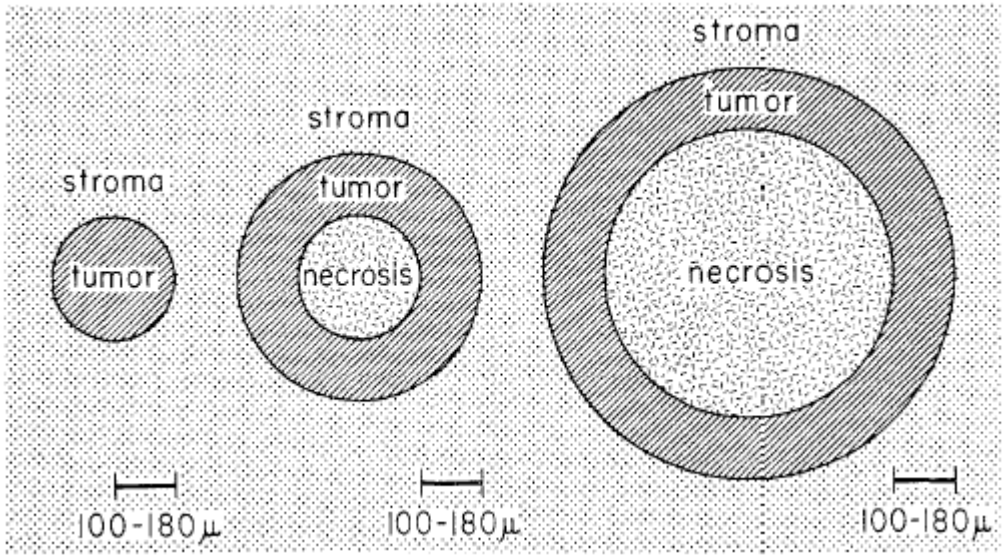
對放射線有抵抗性： S (DNA合成期) 後期

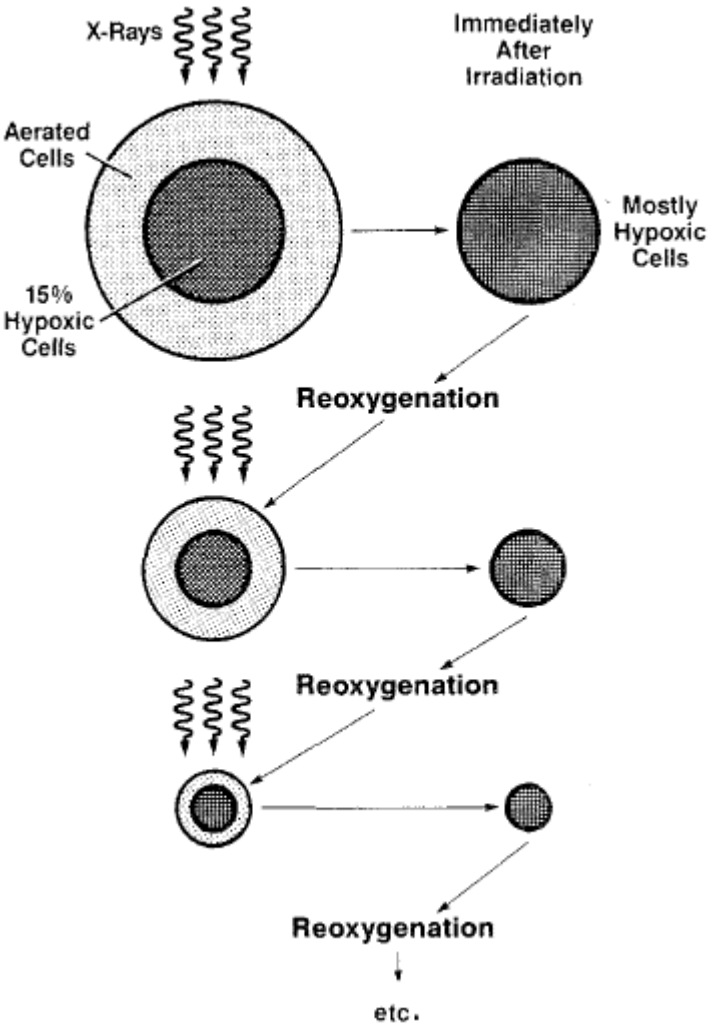
3. 讓細胞有氧可以加強治療效果 (Reoxygenation)






Venous end
Arterial end
<70μ
70μ
Normoxic
Hypoxic viable
Anoxic cells


stroma
tumor
stroma
tumor
necrosis
stroma
tumor
necrosis
100-180μ
100-180μ
100-180μ


X-Rays
Immediately After Irradiation
Aerated Cells
15% Hypoxic Cells
Mostly Hypoxic Cells
Reoxygenation
Reoxygenation
Reoxygenation
etc.

放射治療的適應症

- 主肝門靜脈血栓阻塞
- 右心房或下腔靜脈血栓阻塞
- 動靜脈廔管 (AV shunting)
- 無法手術或栓塞之巨大腫瘤
- 阻塞性黃疸
- 腹腔淋巴轉移

- 遠處轉移（腦、骨頭.....）

放射治療的禁忌

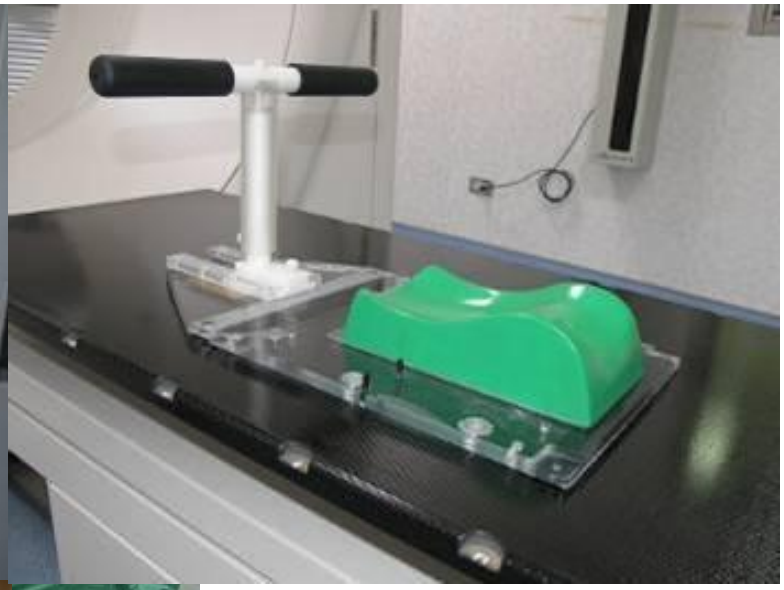
- 黃疸指數（T. Bilirubin）太高，最好在3.0以下。若是肝門靜脈阻塞，則以5.0以下為標準。
- 白血球（WBC）太低
  - 1500以下是絕對禁忌
  - 1500-2500則屬相對禁忌
- 肝功能指數（GPT）太高
  - 超過300是絕對禁忌
  - 100-300則屬相對禁忌

放射治療的流程

醫療團隊

- 醫師：提供病人癌症諮詢及是否接受放射線治療，以及醫療照顧，決定治療範圍及計畫
- 物理師/劑量師：擬定治療計畫，治療機器的品質保證及安裝，治療劑量的計算及驗證，輻射防護業務，新治療技術研發
- 放射師：模具製作，模擬攝影定位，治療機器的操作
- 護理師：病人護理照護，簡易衛教，協助侵入性醫療行為

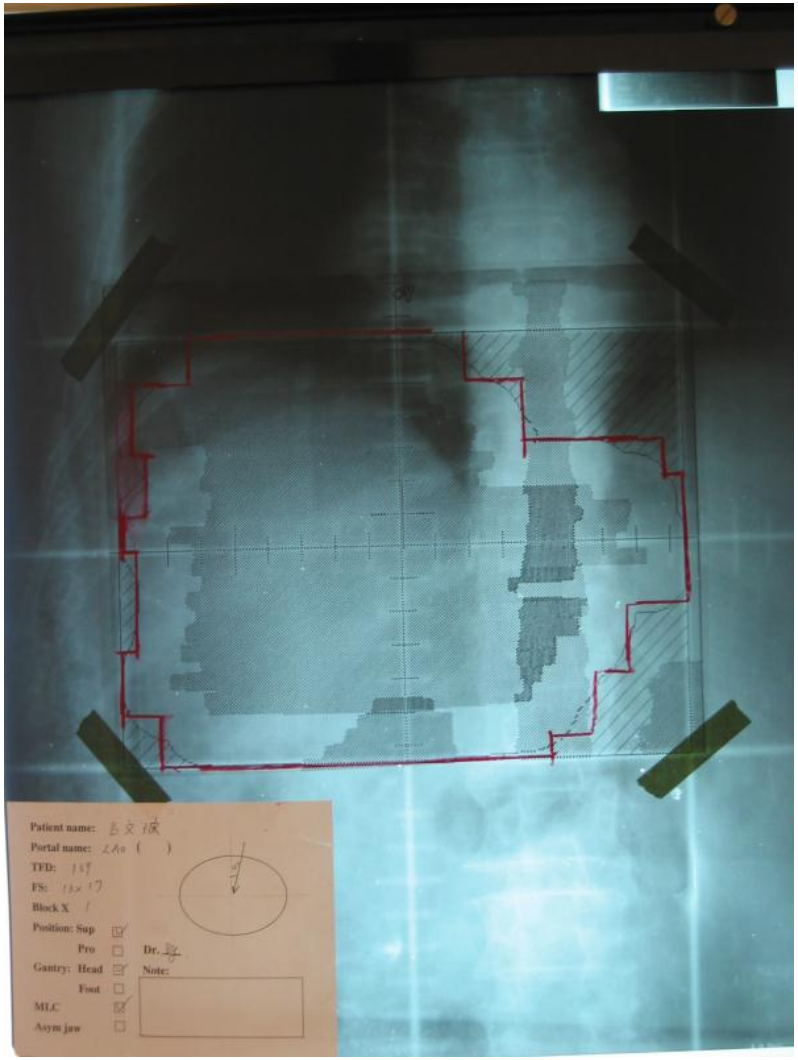
1.A. 製作固定器具



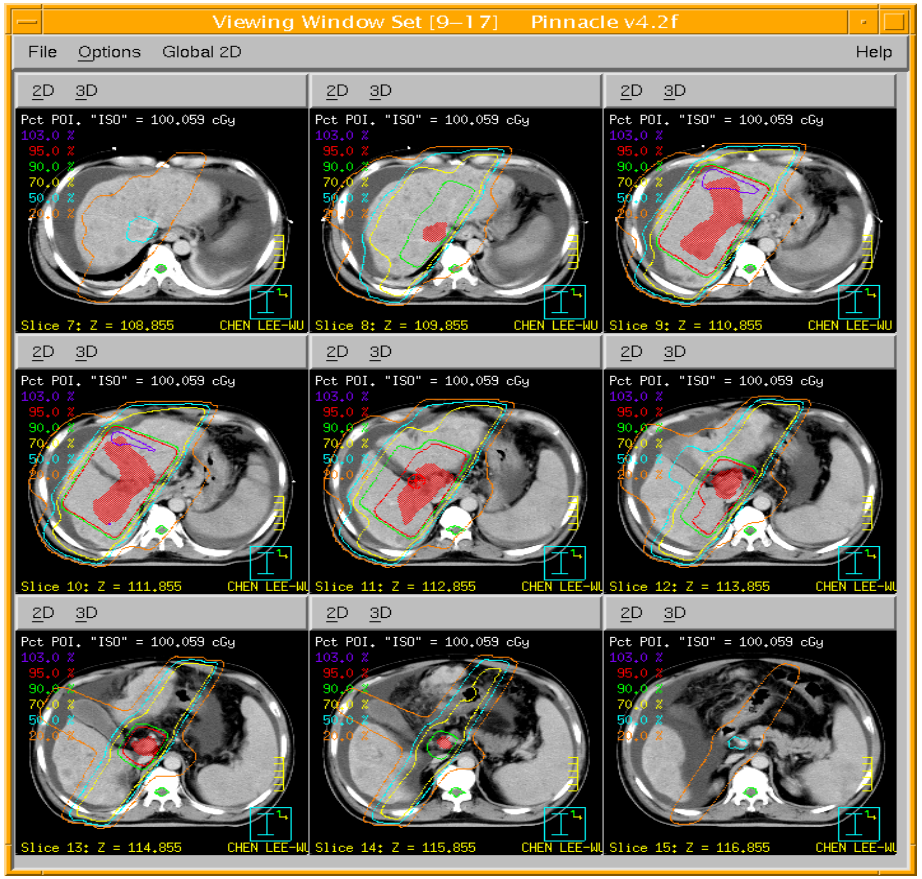
1.B. X光模擬攝影定位

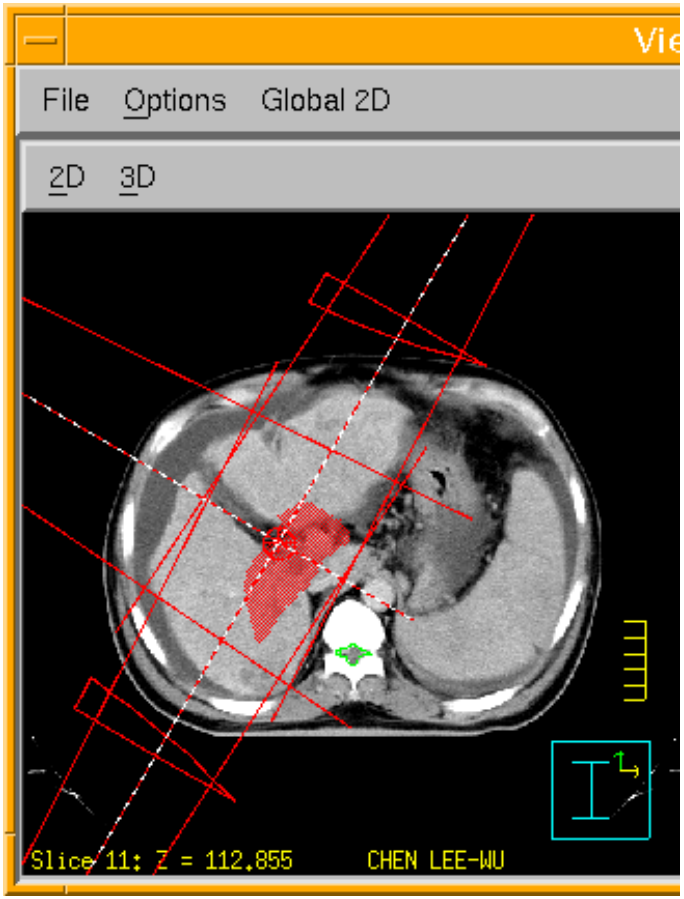
1.C. 電腦斷層攝影

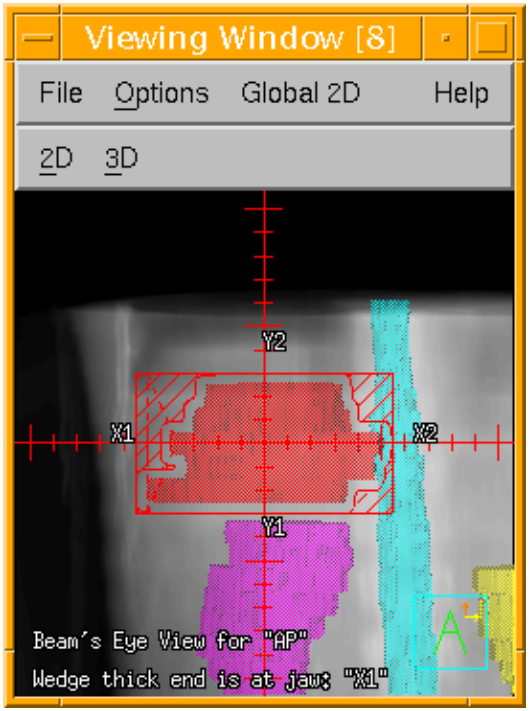
2.A. 傳統治療計畫擬定

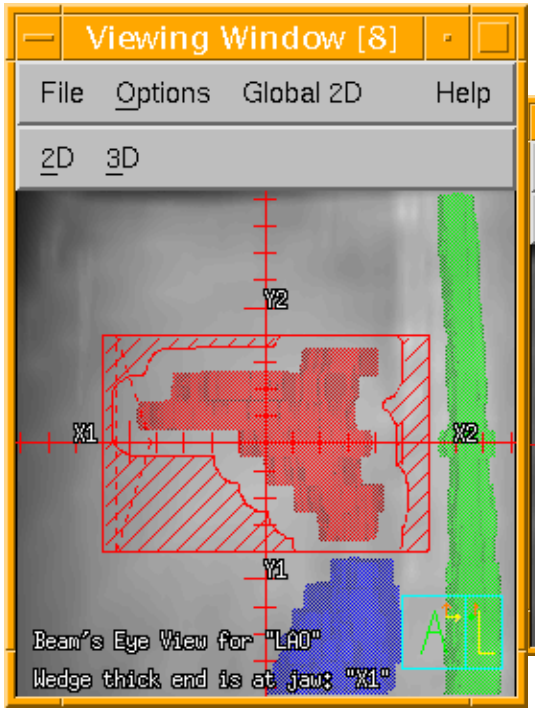

Patient name:
Portal name:
TFD:
FS:
Block X
Position: Sup
Pro
Gantry: Head
Foot
MLC
Asym jaw
Dr.
Note:

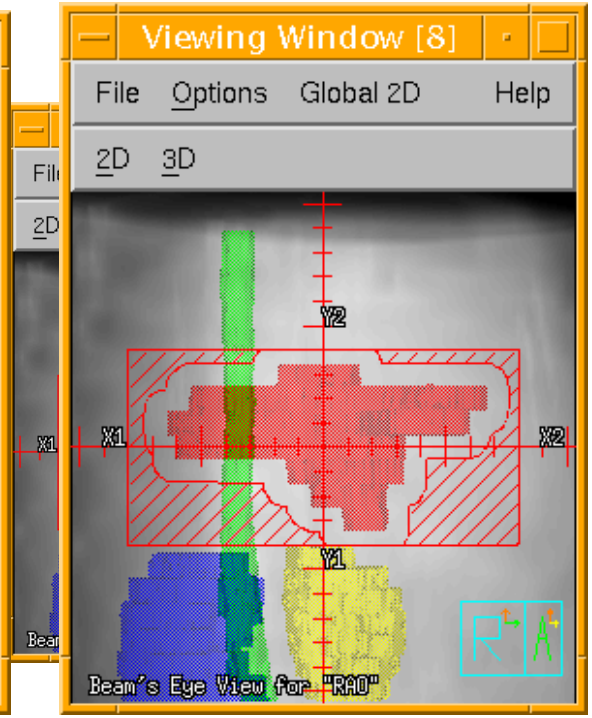
2.B. 電腦治療計畫擬定


Viewing Window Set [9–17] Pinnacle v4.2f
File Options Global 2D Help
2D 3D
Pct POI. "ISO" = 100.059 cGy
103.0 %
95.0 %
90.0 %
70.0 %
50.0 %
20.0 %
Slice 7: Z = 108.855 CHEN LEE-WU
Slice 8: Z = 109.855 CHEN LEE-WU
Slice 9: Z = 110.855 CHEN LEE-WU
Slice 10: Z = 111.855 CHEN LEE-WU
Slice 11: Z = 112.855 CHEN LEE-WU
Slice 12: Z = 113.855 CHEN LEE-WU
Slice 13: Z = 114.855 CHEN LEE-WU
Slice 14: Z = 115.855 CHEN LEE-WU
Slice 15: Z = 116.855 CHEN LEE-WU

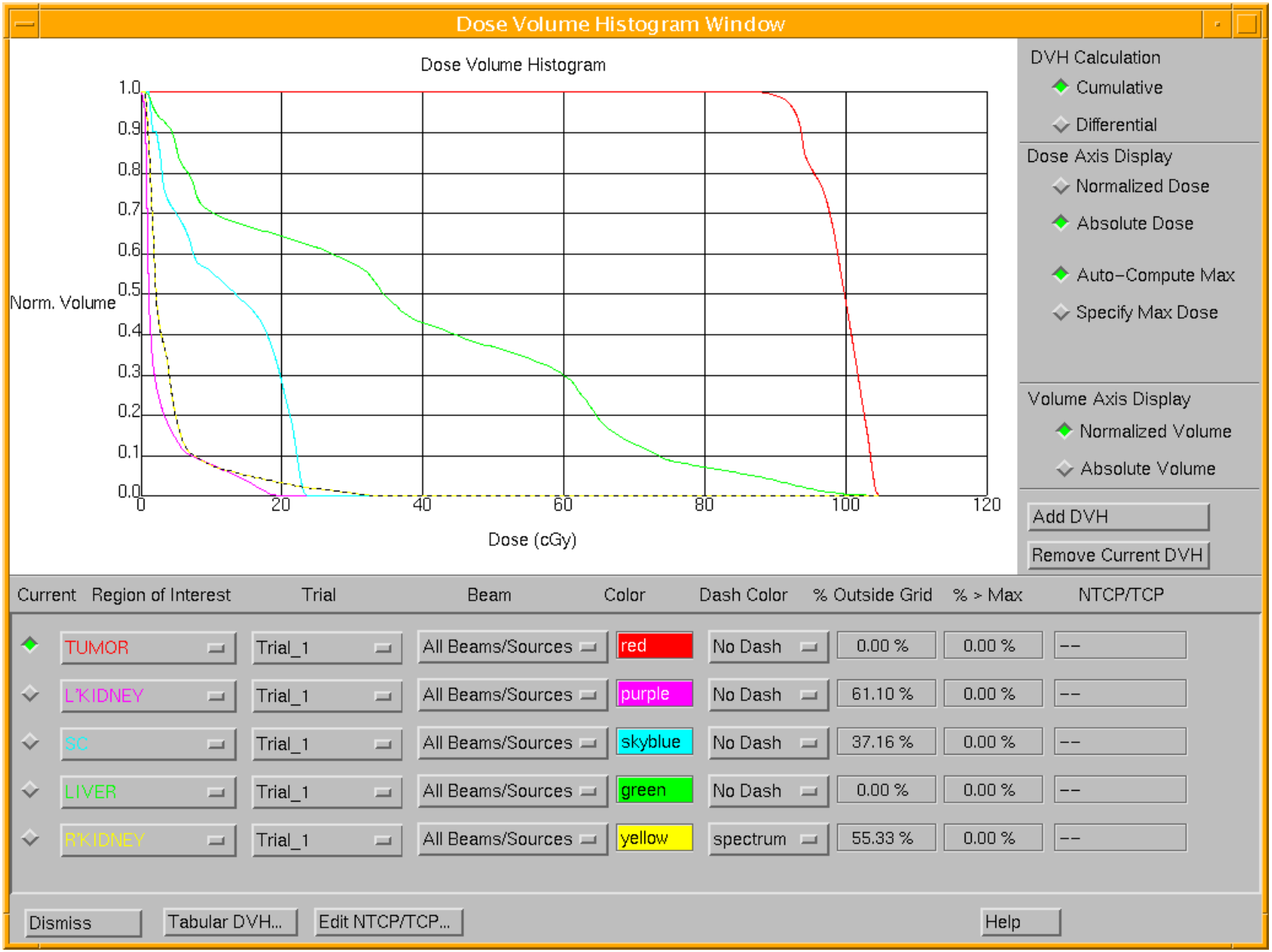

File Options Global 2D
2D 3D
Slice 11: Z = 112.855 CHEN LEE-WU


Viewing Window [8]
File
Options
Global 2D
Help
2D
3D
Y2
X1
X2
Y1
Beam's Eye View for "AP"
Wedge thick end is at jaw: "X1"

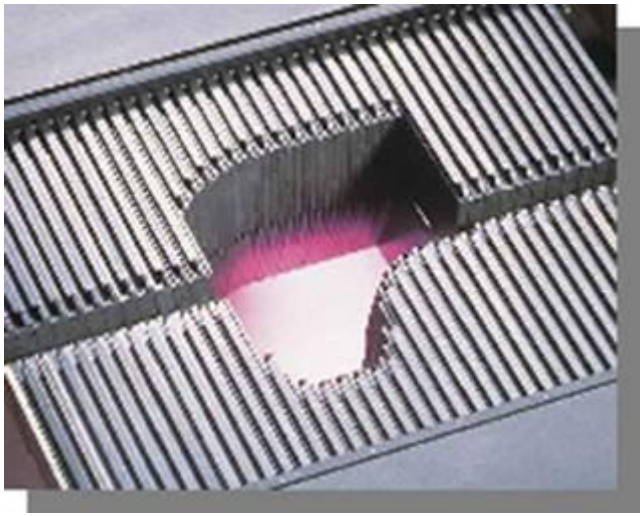

Viewing Window [8]
File
Options
Global 2D
Help
2D
3D
Y2
X1
X2
Y1
Beam's Eye View for "LAO"
Wedge thick end is at jaw: "X1"


Viewing Window [8]
File
Options
Global 2D
Help
2D
3D
Y2
X1
X2
Y1
Beam's Eye View for "RAO"

3D-Conformal Radiotherapy



3. 模具製作或將參數輸入治療機



4. 治療病人

常用的放射劑量

- 50~60格雷/20~30次

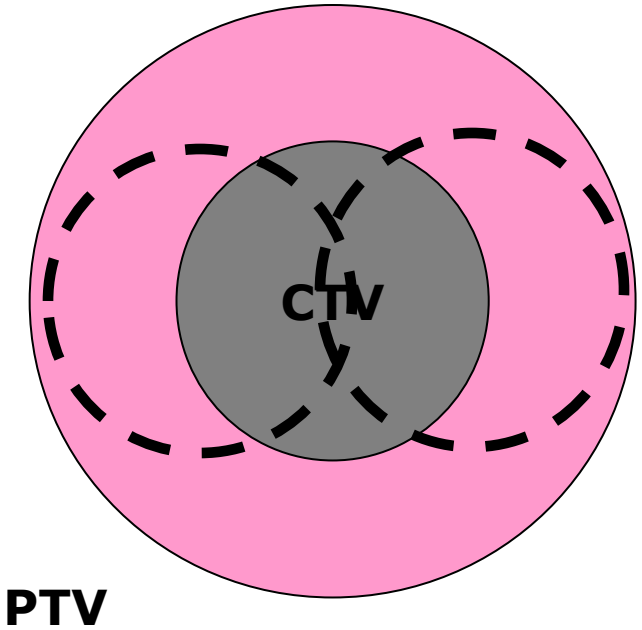
- 放射治療的時間是星期一到星期五，每天一次
- 每天在治療室中約十至十五分鐘，此時只有一人在治療室內，務必放鬆心情、靜躺不動且平和呼吸。
- 在這4-6週的時間，每週會有一次的例行門診，主治醫師會針對治療的副作用給予適當的治療。

放射治療的技術

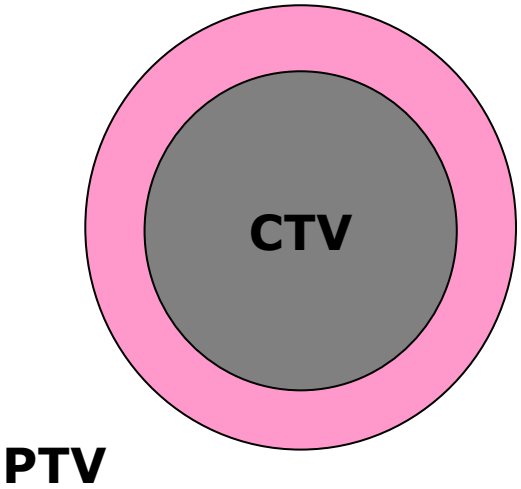
放射治療技術

- Conventional (傳統治療)
- 3D conformal technique (三度空間順形治療)
- IMRT (強度調控治療)
- IGRT (影像導引治療)
- Tomotherapy (螺旋斷層放射治療)
- Stereotactic Radiosurgery (立體定位放射手術)
  - Gamma knife
  - Cyber knife
  - Novalis
  - Proton

影像導引治療 (IGRT)



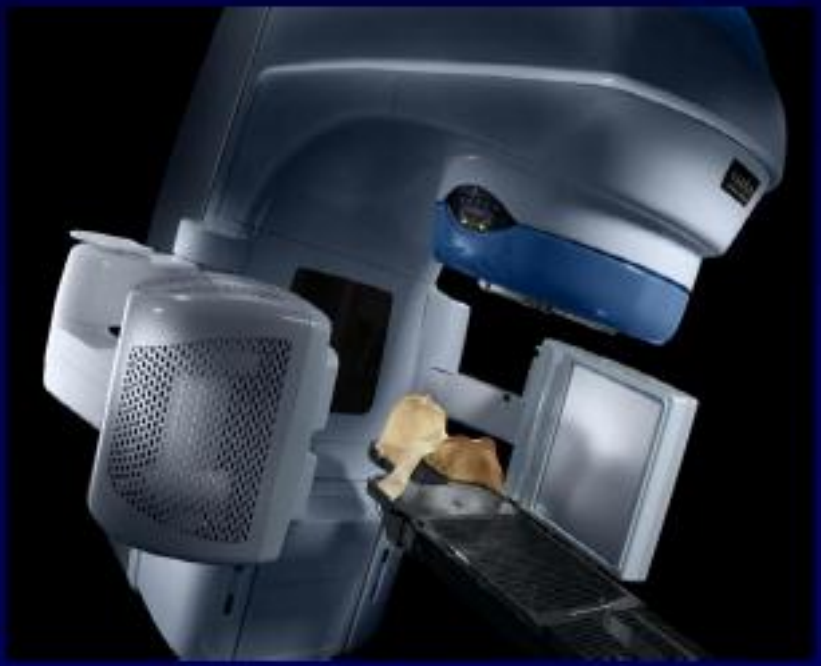
Without Imaging



With Imaging

The Role of the On-Board Imager

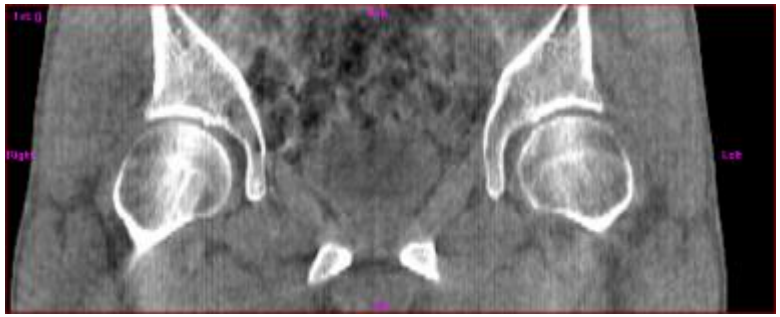
- The On-Board Imager™(OBI) provides improved tumor targeting and motion management with high-resolution, low-dose imaging in the treatment room.



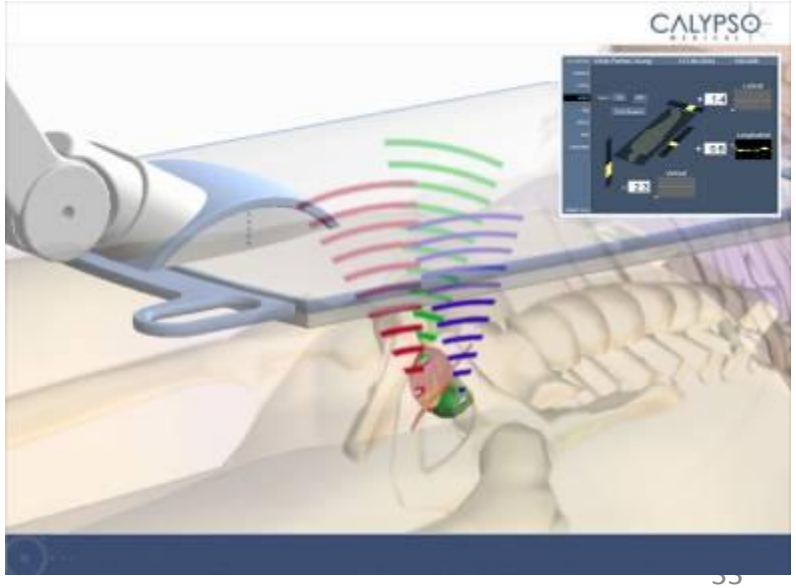
影像導引治療 (IGRT)

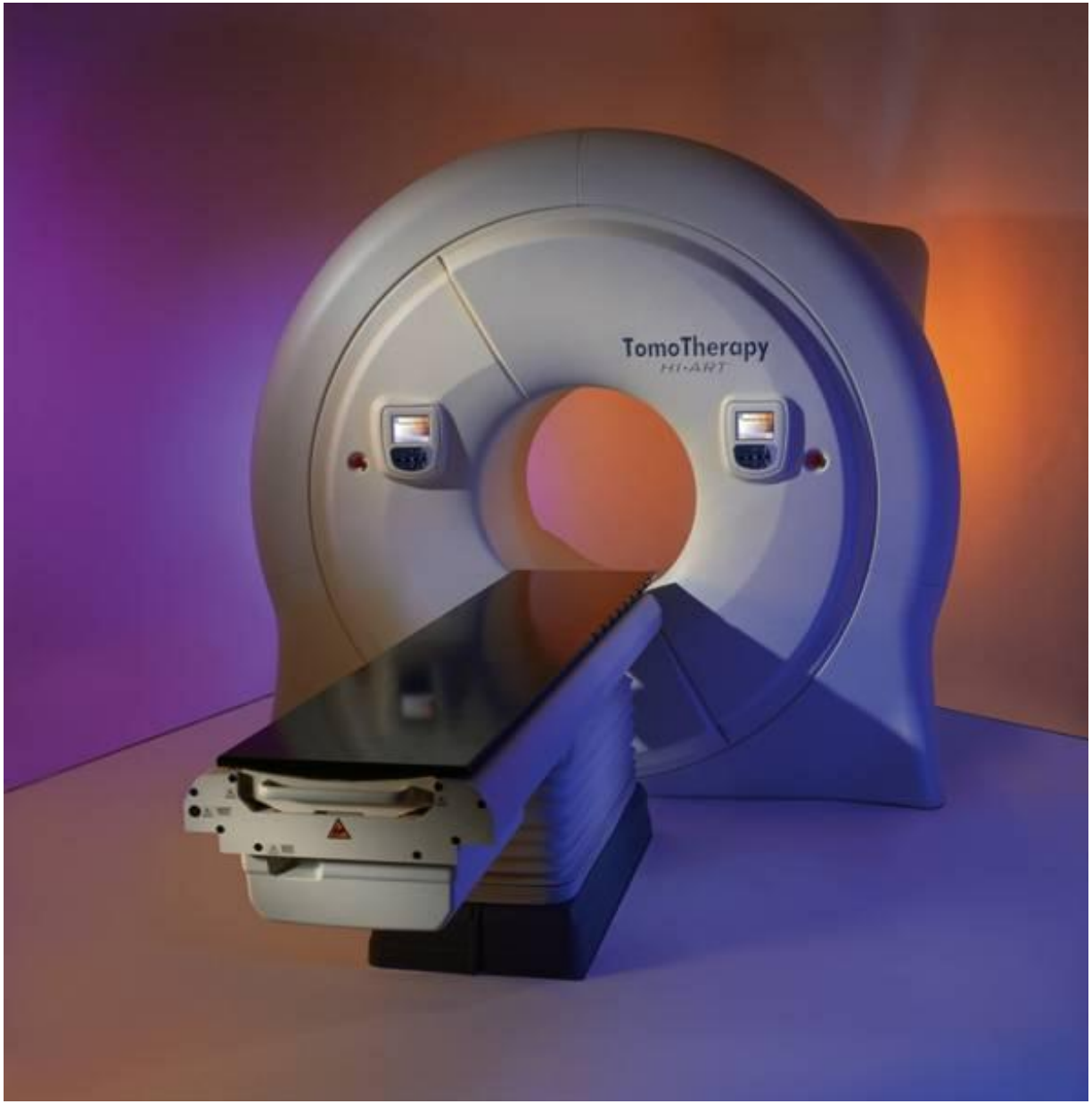
影像導引治療 (IGRT)

Cone-beam CT



Echography

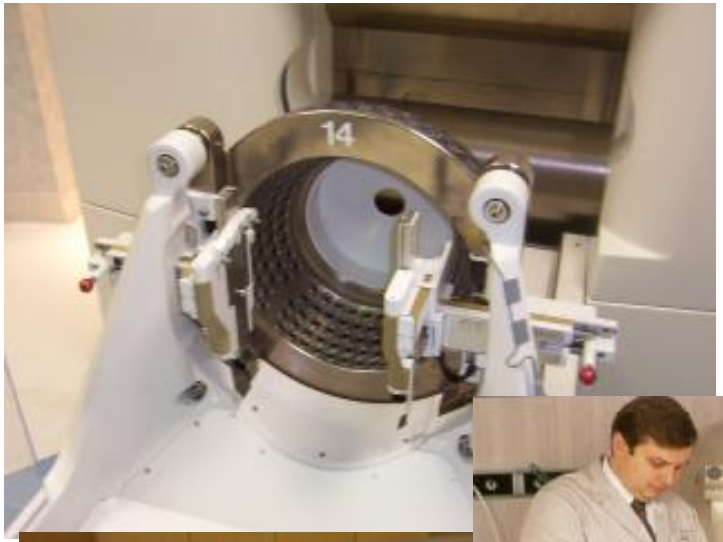



TomoTherapy
HI·ART

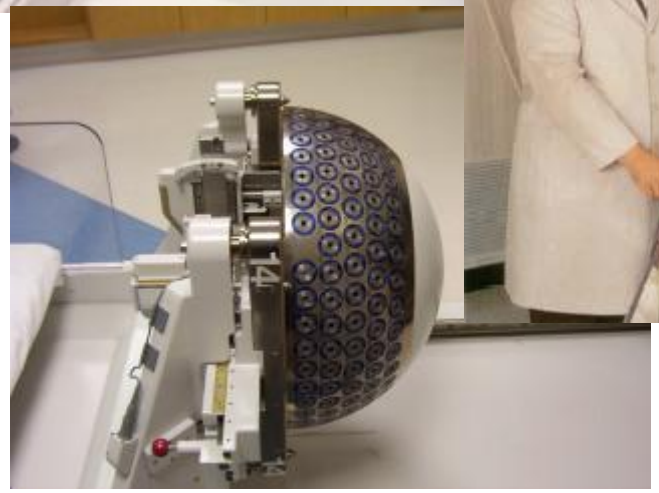
立體定位放射手術 (SRS)

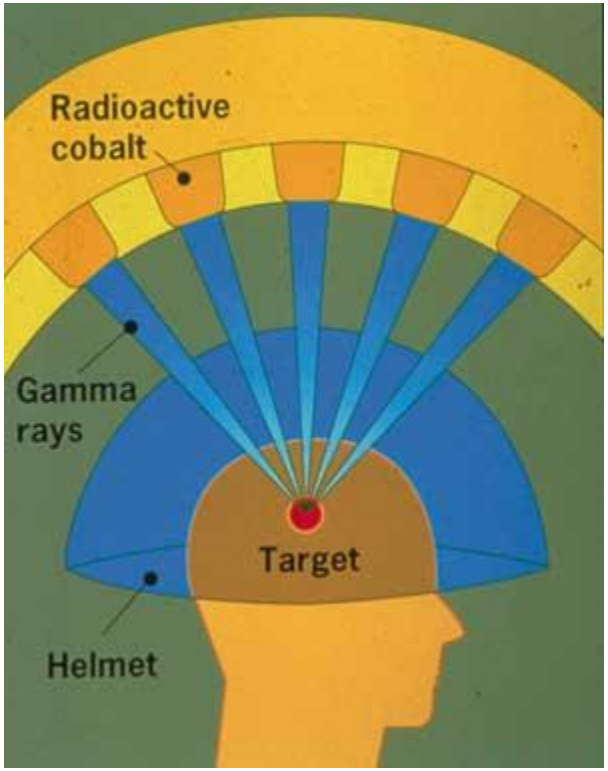
- Source
  - X-rays (Linac base X knife, Cyberknife)
  - Gamma rays (Gamma knife)
  - Charged particles (Protons, etc.)

立體定位放射手術 (SRS)



Gamma knife





立體定位放射手術(SRS)

cyberknife

放射治療的副作用

急性可逆副作用

- 部分胃部及小腸接受放射線照射會造成食慾不振、噁心、嘔吐及腹瀉的現像。
- 急性的反應一般直到治療完成後約三週才會完全褪去。
- 肝功能異常
- 血球功能低下
- 腫瘤熱
- 局部疼痛

- 對於B型肝炎的帶原者，由於放射線照射了部份的正常肝臟，可能會引起B型肝炎病毒的再活化，會表現出肝轉氨酵素（GOT與GPT）上升及黃膽的症狀，而導致放射治療必需暫停
- 為了避免上述的狀況，我們會建議患者在開始放射治療的同時合併服用抗病毒藥物三至六個月，以預防B型肝炎病毒的再活化。

RILD (Radiation induced liver disease) Radiotherapy and Oncology 63 (2002) 41–45

- Patients were evaluated for evidence of RILD within 4 months from completion of radiotherapy.
- RILD was defined as either anicteric elevation of alkaline phosphatase level of at least twofold and non-malignant ascites (classic RILD), or elevated transaminases of at least fivefold the upper limit of normal or of pre-treatment level (Grade 3 or 4 hepatic toxicity of Common Toxicity Criteria Version 2.0 by National Cancer Institute) (non-classic RILD), in the absence of documented progressive disease.

慢性不可逆副作用

- 慢性的肝功能衰退及腎功能衰退，此二項副作用可能在治療後的六個月至數年內發生。

治療效果

台中澄清醫院

- 小型肝癌（<5公分）：一年和兩年存活率分別為97.4%和62.6%。
- 肝門靜脈阻塞：反應率約為60%， 一年存活率為55.4%。
- 晚期肝癌：
  - 治療結束後一個月平均腫瘤體積變小29%，二個月體積減少41%，三個月為55%
  - 治療前甲型胎兒蛋白 (AFP) 升高的病人中，88%在治療後第一個月AFP均降低，其中59%更於治療後一個月時AFP降低到治療前的一半以下。

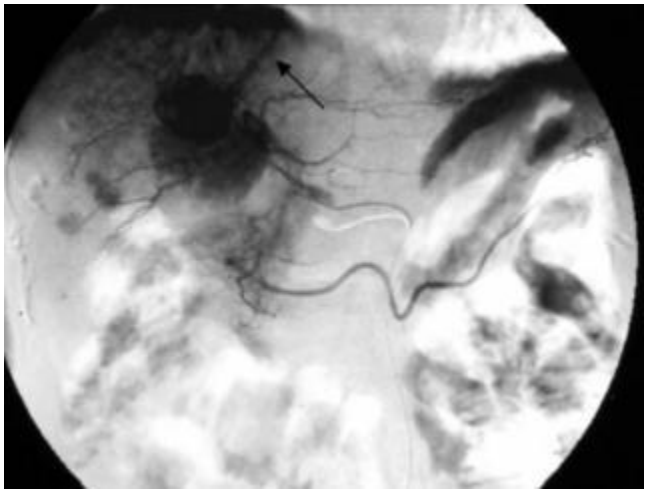
RT for PVT (高雄長庚)

- 放射線治療對於門靜脈栓塞之打通率約為53%，41%之病人接受放射線治療後可接受進一步的栓塞治療。

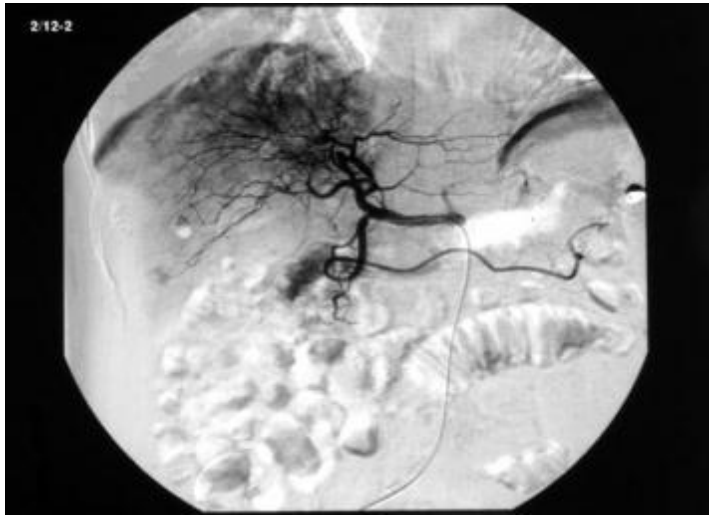
Therapeutic Radiology and Oncology 2001 March; 8(1) 1-14

RT for AVS

- 放射線治療對於肝動脈與門靜脈(或肝靜脈)間不正常之交通之阻塞率約為25%。



放射線治療前



放射線治療後

Thank You!