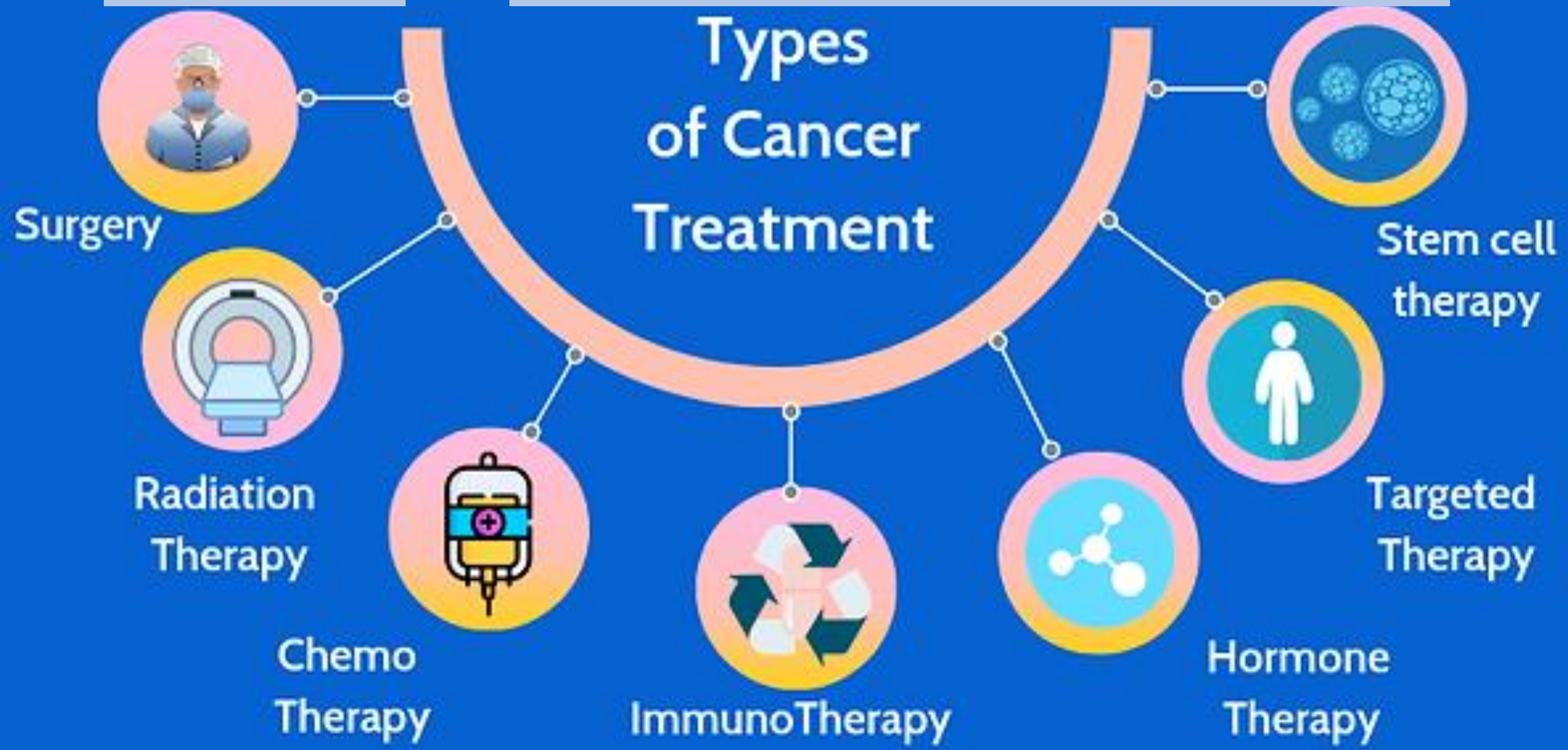
癌症治療新紀元

質子治療、重粒子治療

雲林基督教醫院　放射腫瘤科主任
簡佑安醫師

局部

全身性


Types
of Cancer
Treatment
Surgery
Radiation
Therapy
Chemo
Therapy
ImmunoTherapy
Hormone
Therapy
Targeted
Therapy
Stem cell
therapy

癌症治療新紀元

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雲林基督教醫院　放射腫瘤科主任
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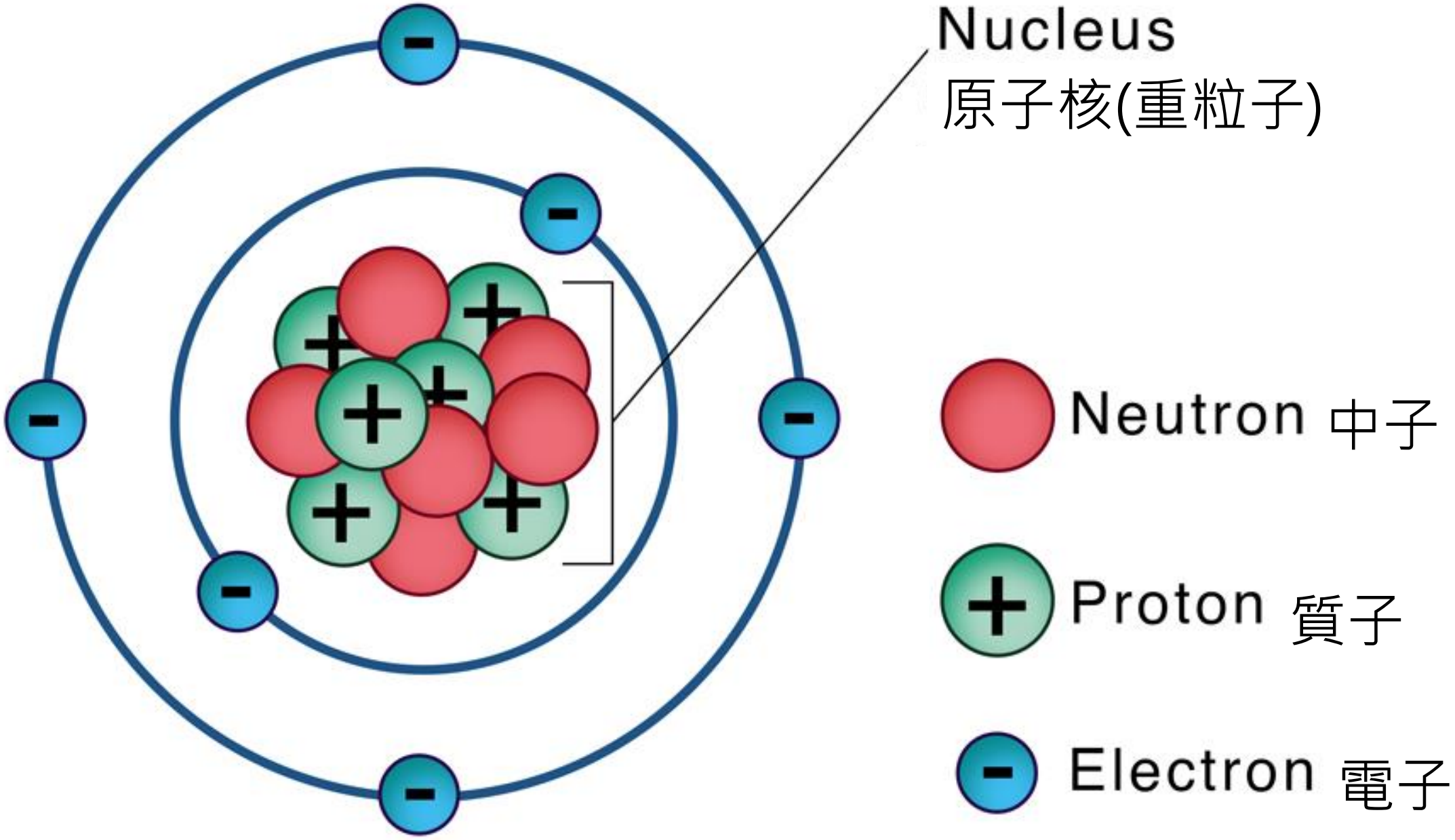

Nucleus
原子核(重粒子)
Neutron 中子
Proton 質子
Electron 電子

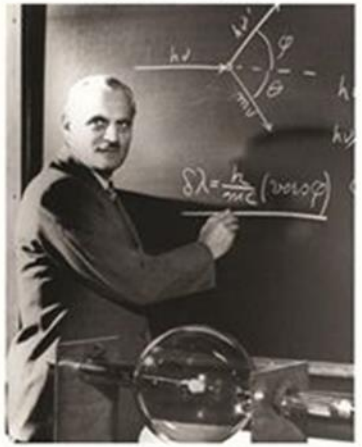
癌症治療新紀元

質子治療、重粒子治療

PART 01

什麼是放射治療

USA Arthur Compton

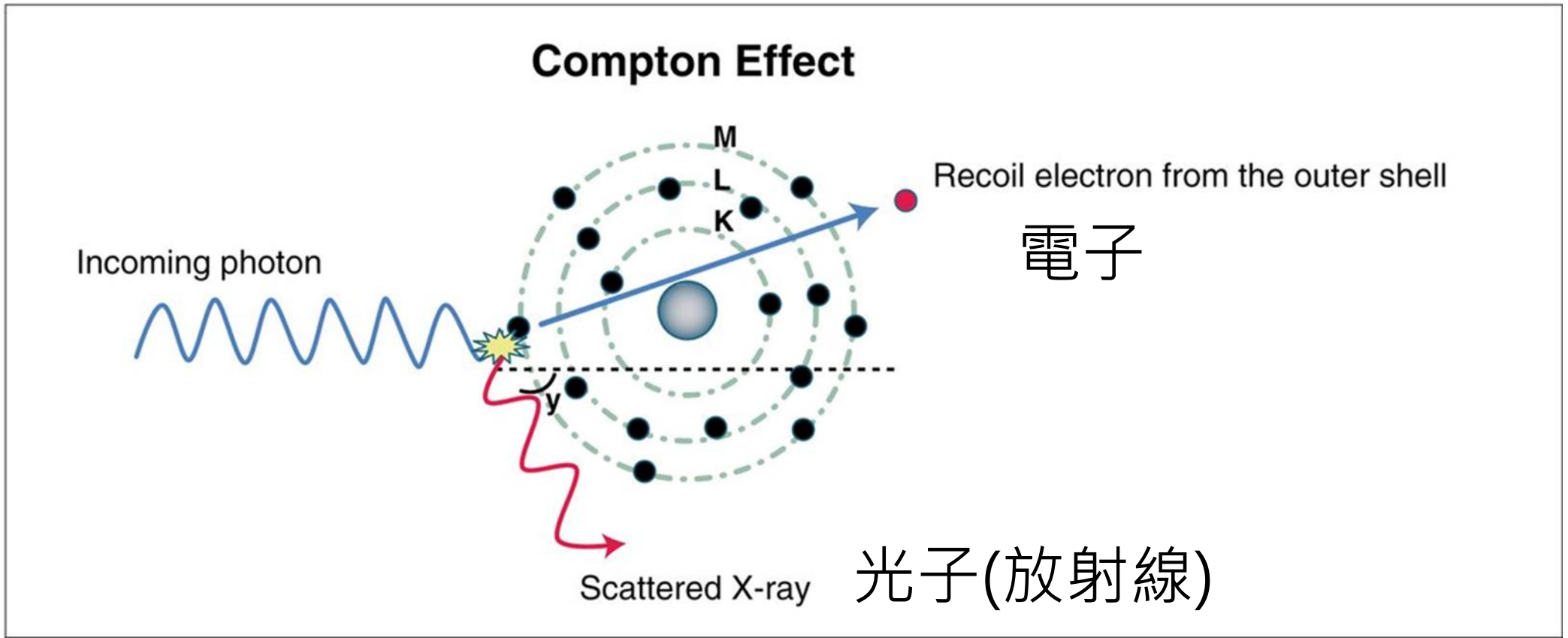


(September 10, 1892 – March 15, 1962)

Compton Scattering 1923

The in-elastic scattering of photons in matter results in a decrease in energy (increase in wavelength) of an X-ray or gamma ray photon and is called the Compton effect.

Part of the energy of the X/gamma ray is transferred to a scattering electron, which recoils and is ejected from its atom (which becomes ionized), and the rest of the energy is taken by the scattered, "degraded" photon.




ELEKTA
Versa HD
Versa HD

Disc-loaded
waveguide for acceleration

Bending magnet

Electron gun

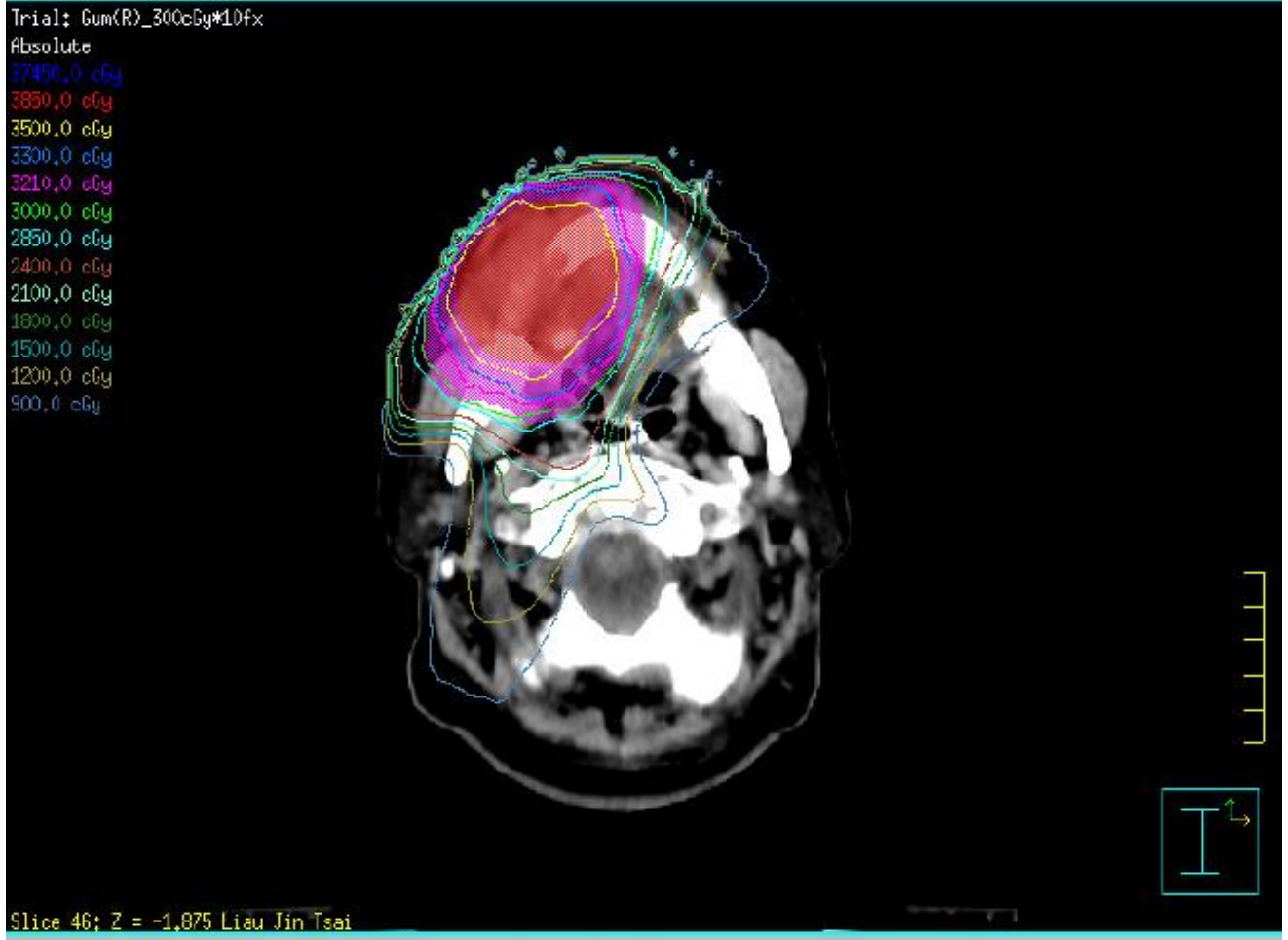
Gantry

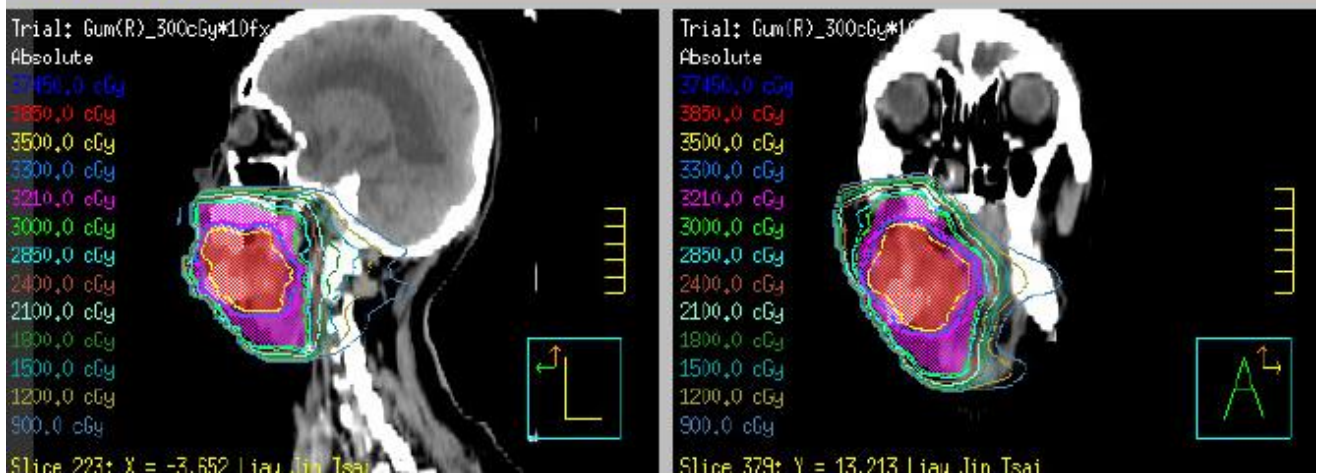
Microwave
amplifier

Treatment head

Couch

RF waveguide



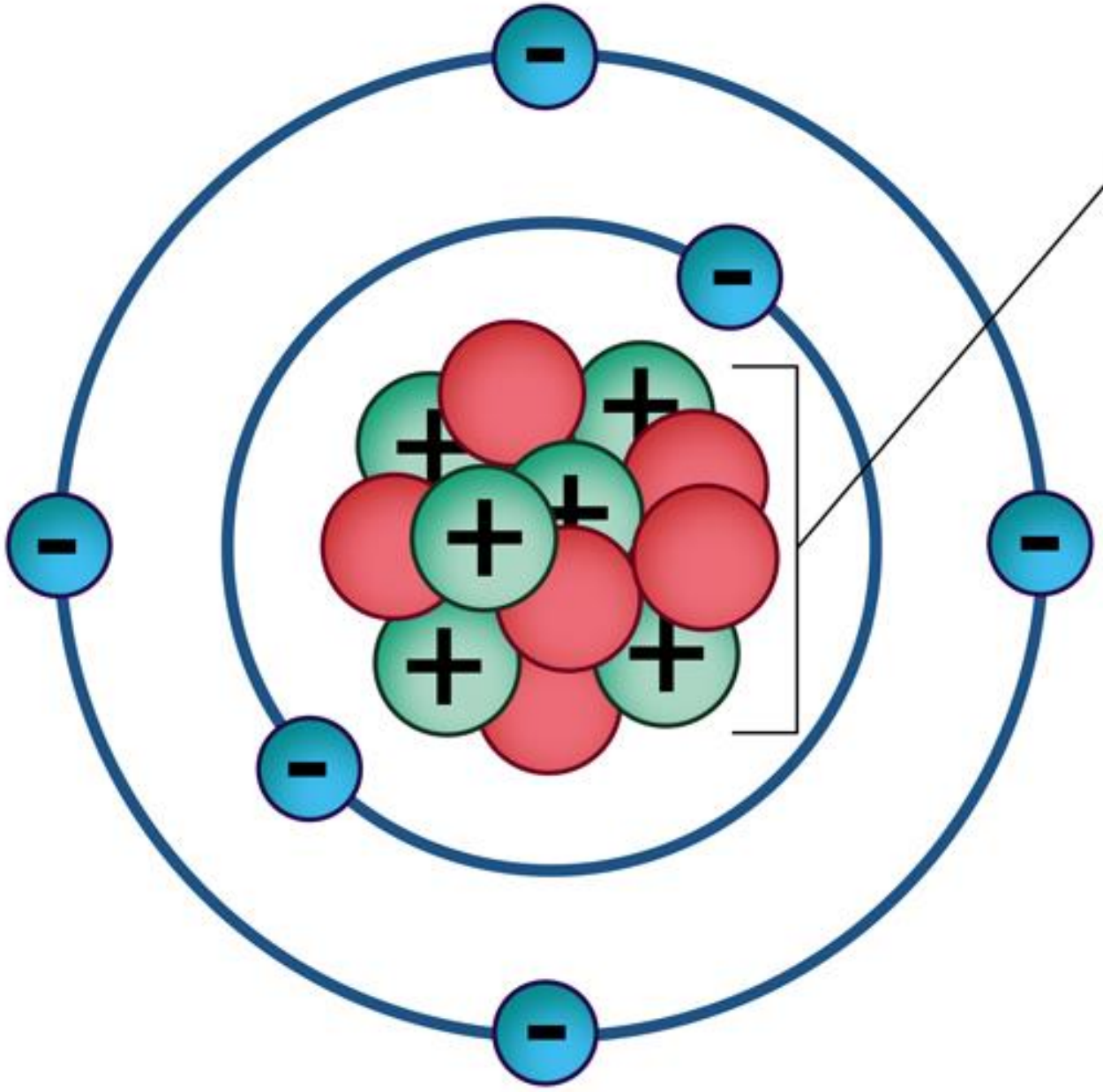


雲基擁有 光子與電子 層級中最頂級的機器

電腦刀/銳速刀/立體定位手術

PART 02

質子治療



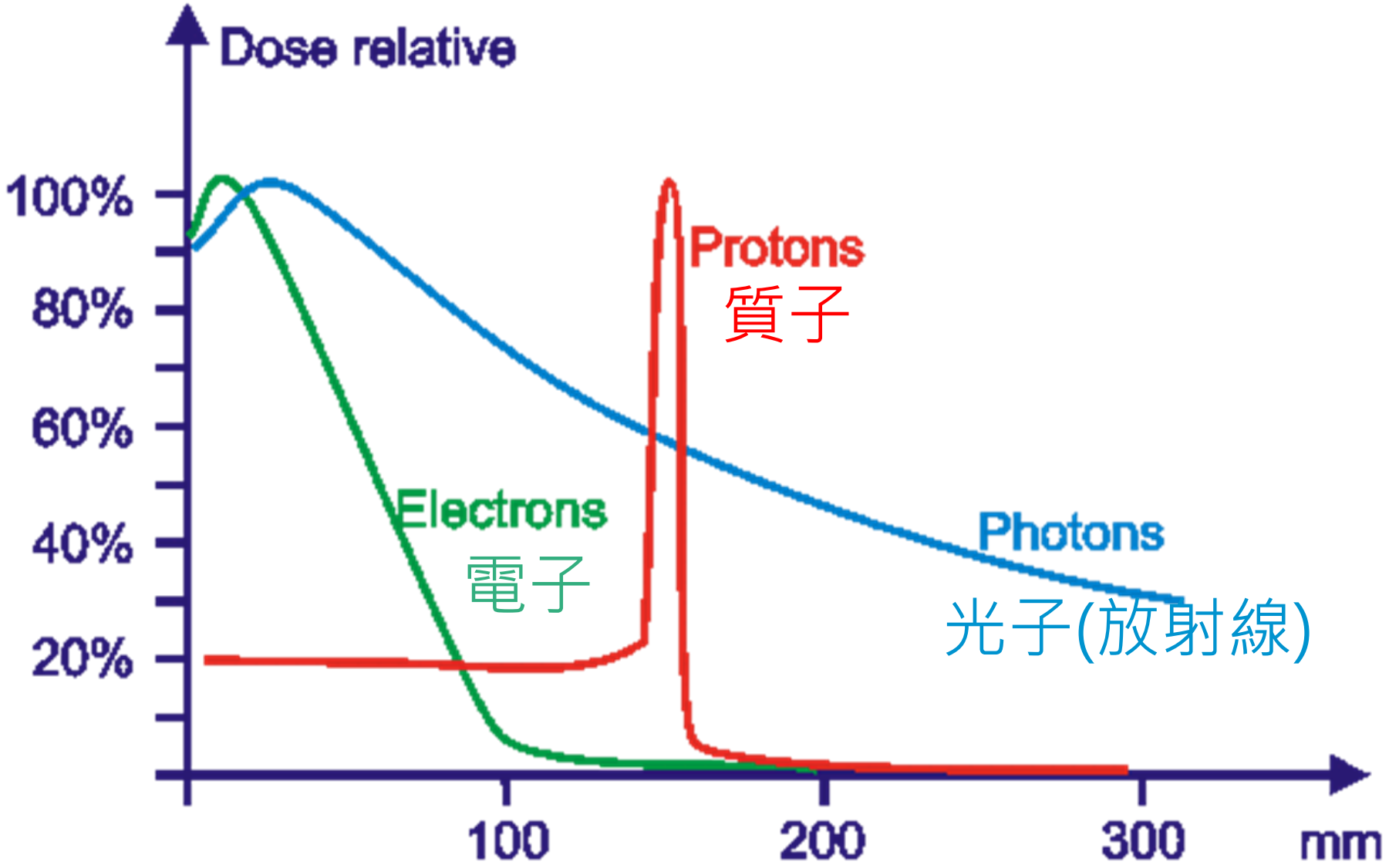
Nucleus
原子核(重粒子)

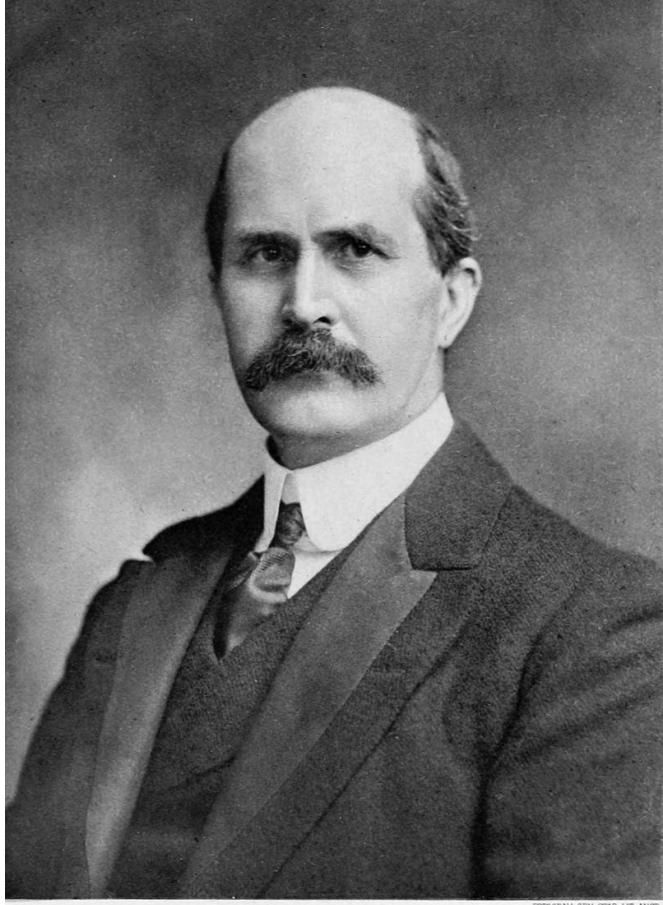
Neutron 中子 1839

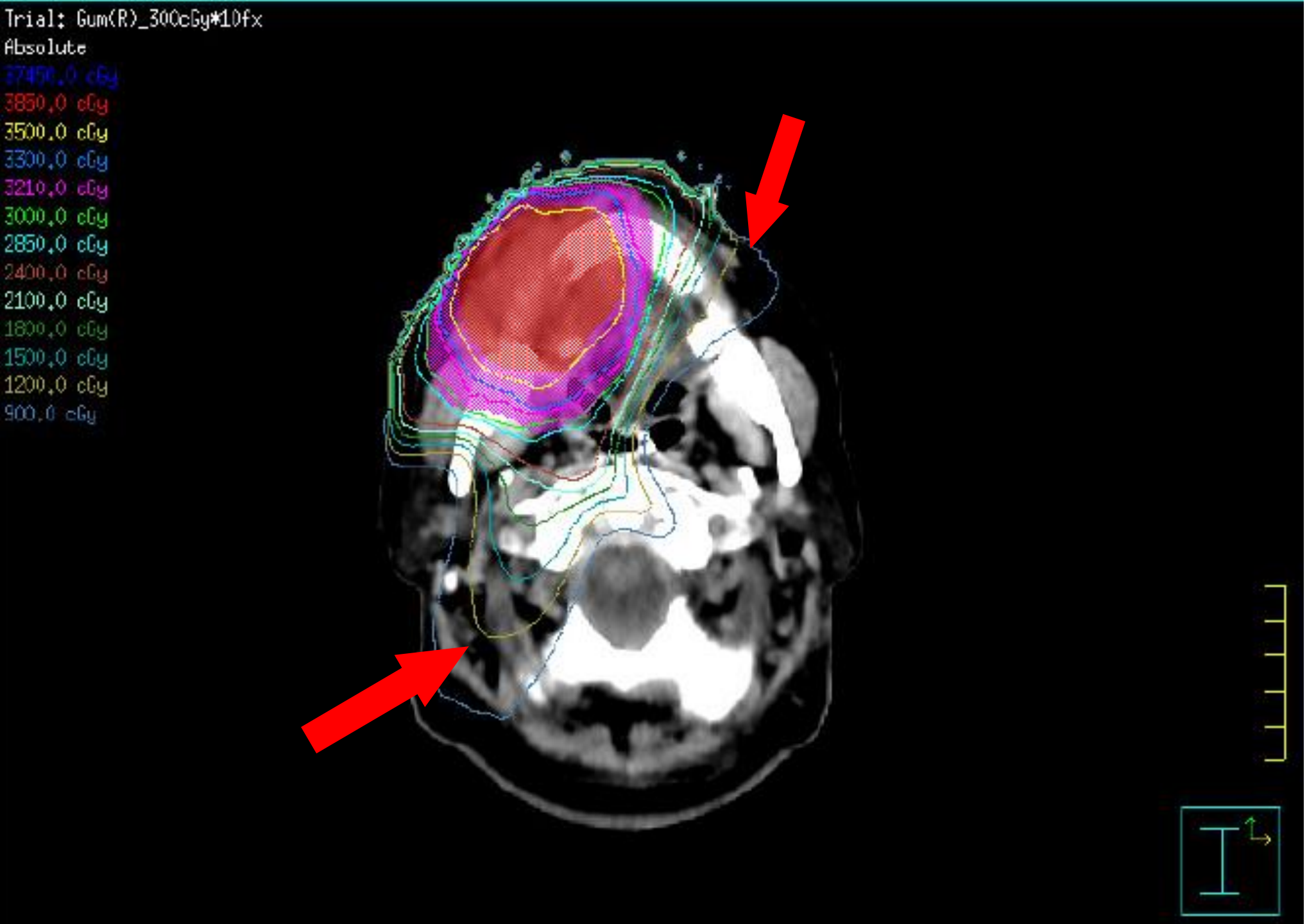
Proton 質子 1836

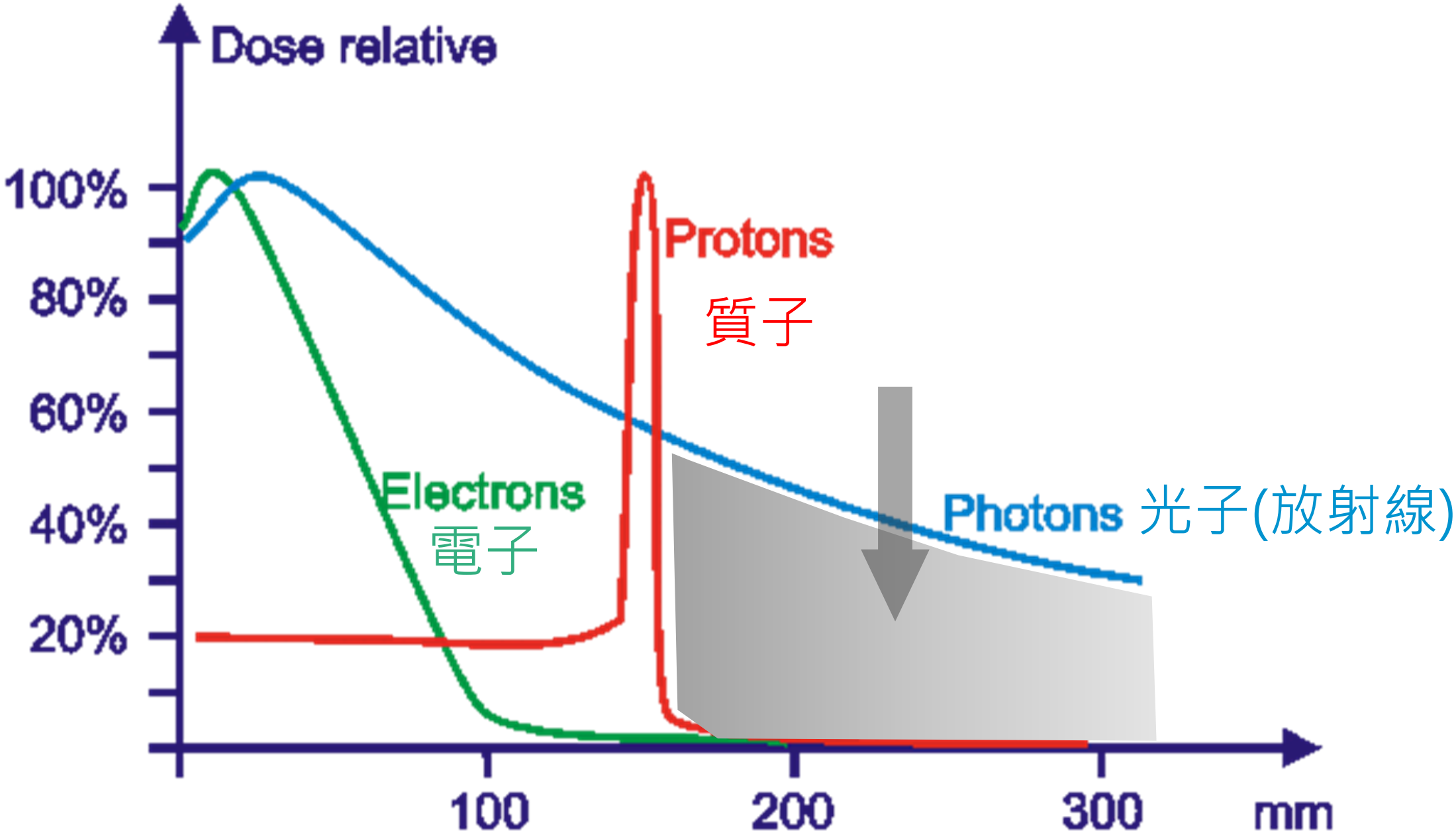
Electron 電子 1

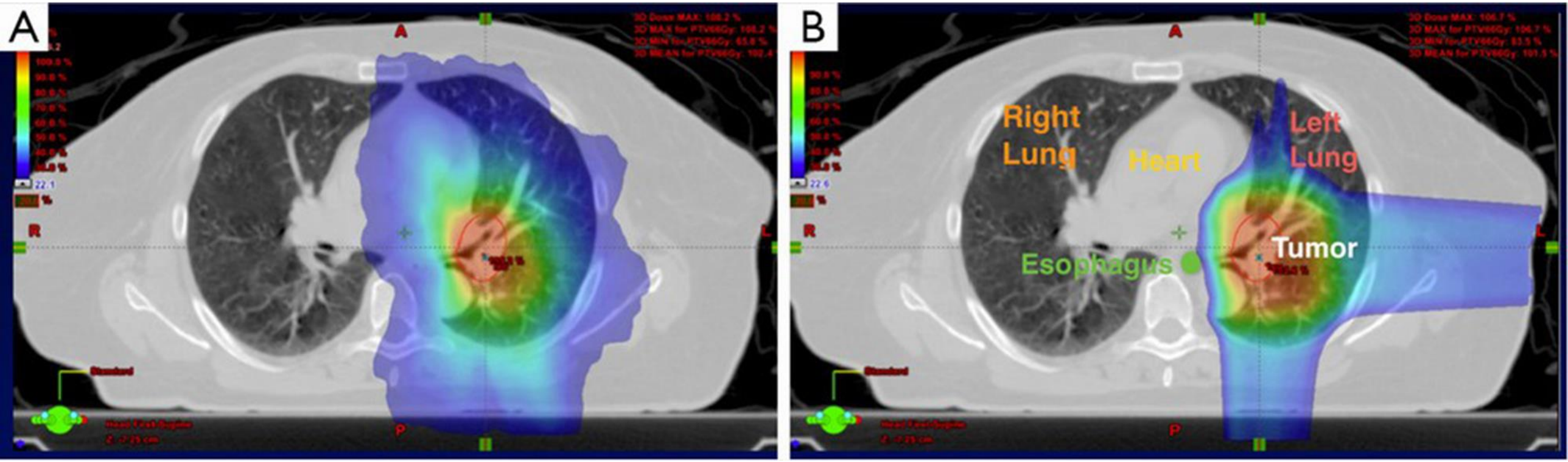
William Henry Bragg, who discovered Bragg peak in 1903

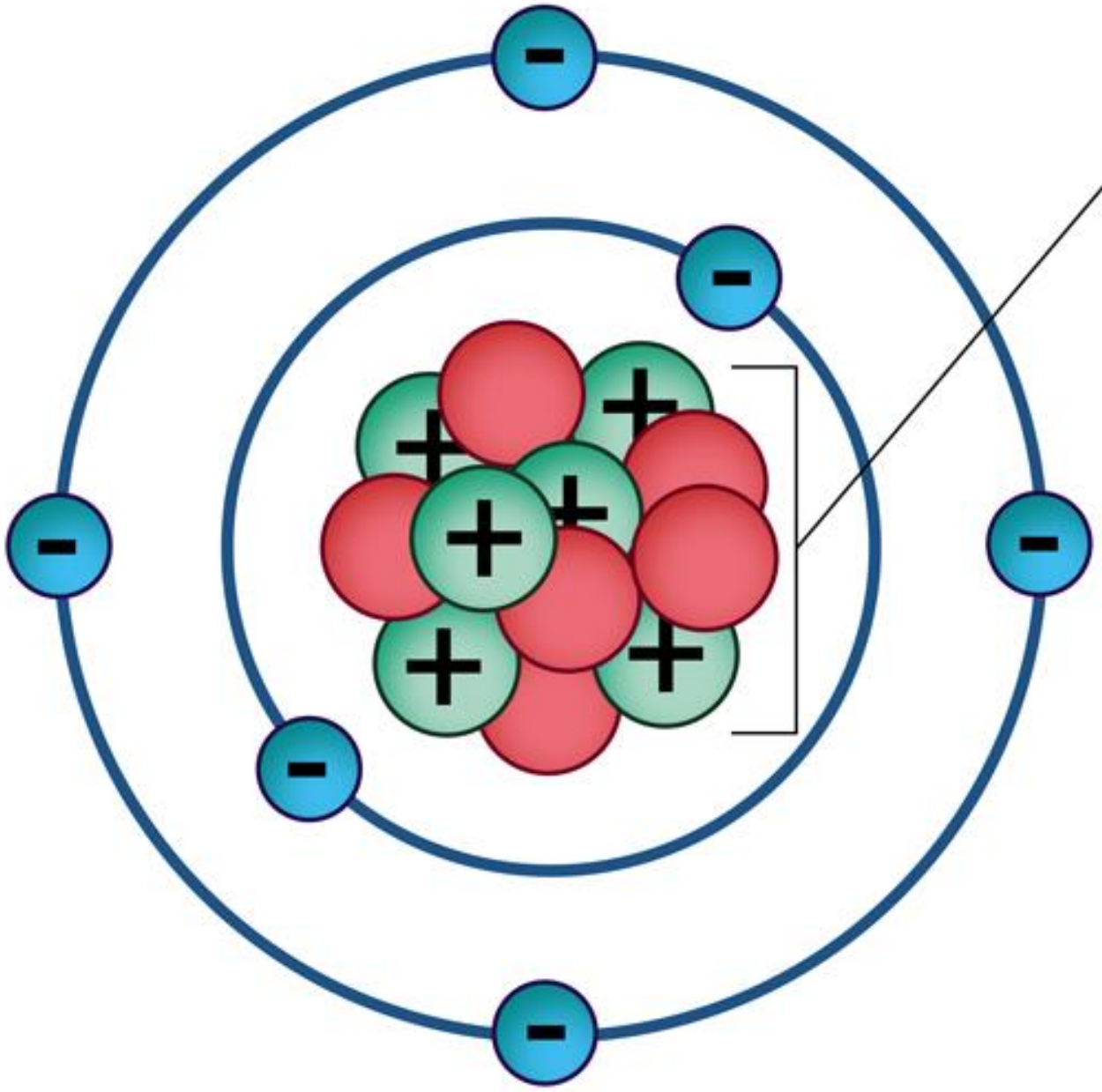





Trial: Gum(R)_300cGy*10fx
Absolute
3850.0 cGy
3500.0 cGy
3300.0 cGy
3210.0 cGy
3000.0 cGy
2850.0 cGy
2400.0 cGy
2100.0 cGy
1800.0 cGy
1500.0 cGy
1200.0 cGy
900.0 cGy


Dose relative
100%
80%
60%
40%
20%
Protons
質子
Electrons
電子
Photons 光子(放射線)
100
200
300
mm


A
B
Right Lung
Heart
Left Lung
Esophagus
Tumor



Nucleus
原子核(重粒子)

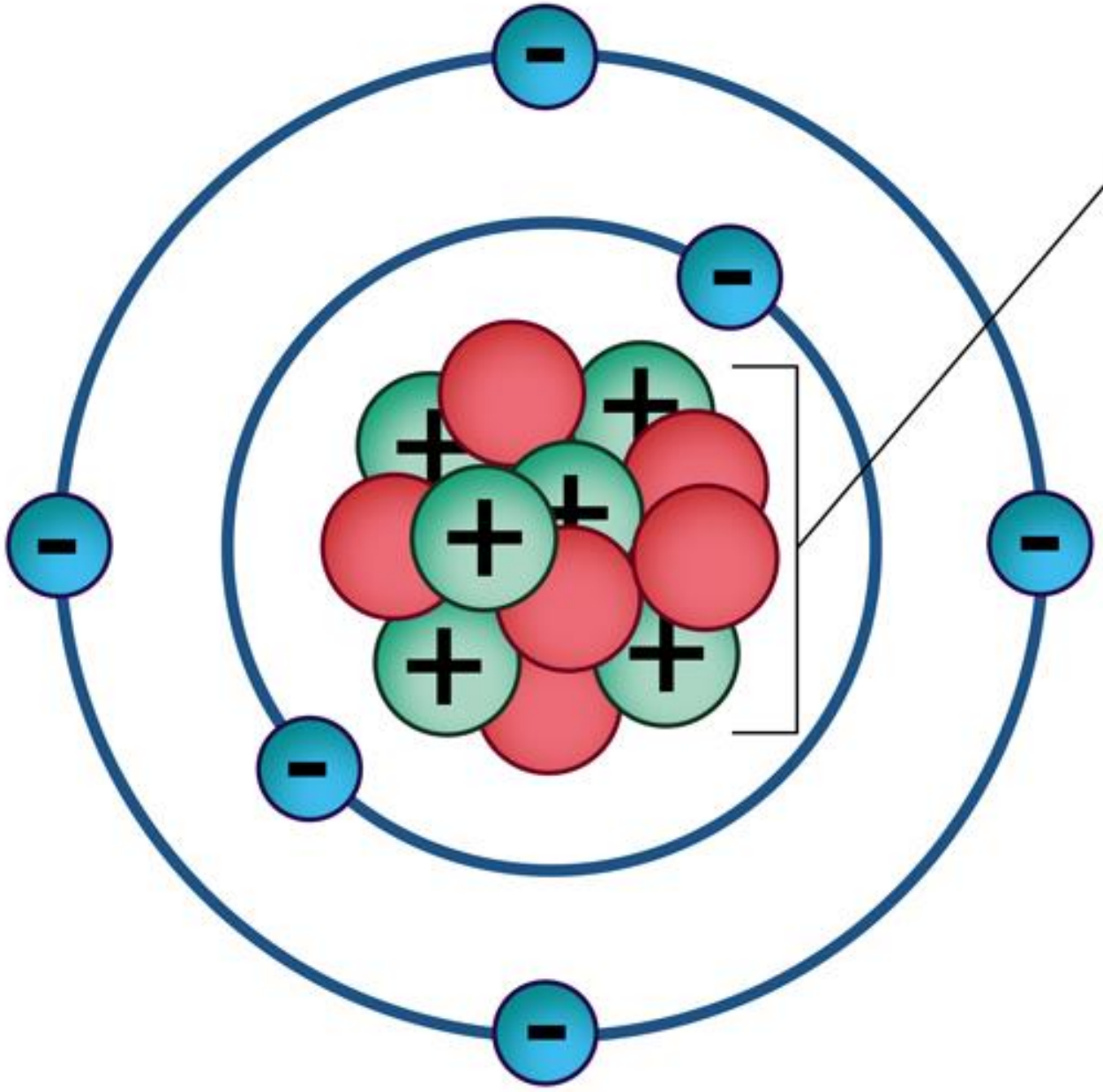
Neutron 中子 1839

Proton 質子 1836

Electron 電子 1

重量決定機器的規模


ELEKTA
Versa HD
Versa HD



Nucleus
原子核(重粒子)

Neutron 中子 1839

Proton 質子 1836

Electron 電子 1

1

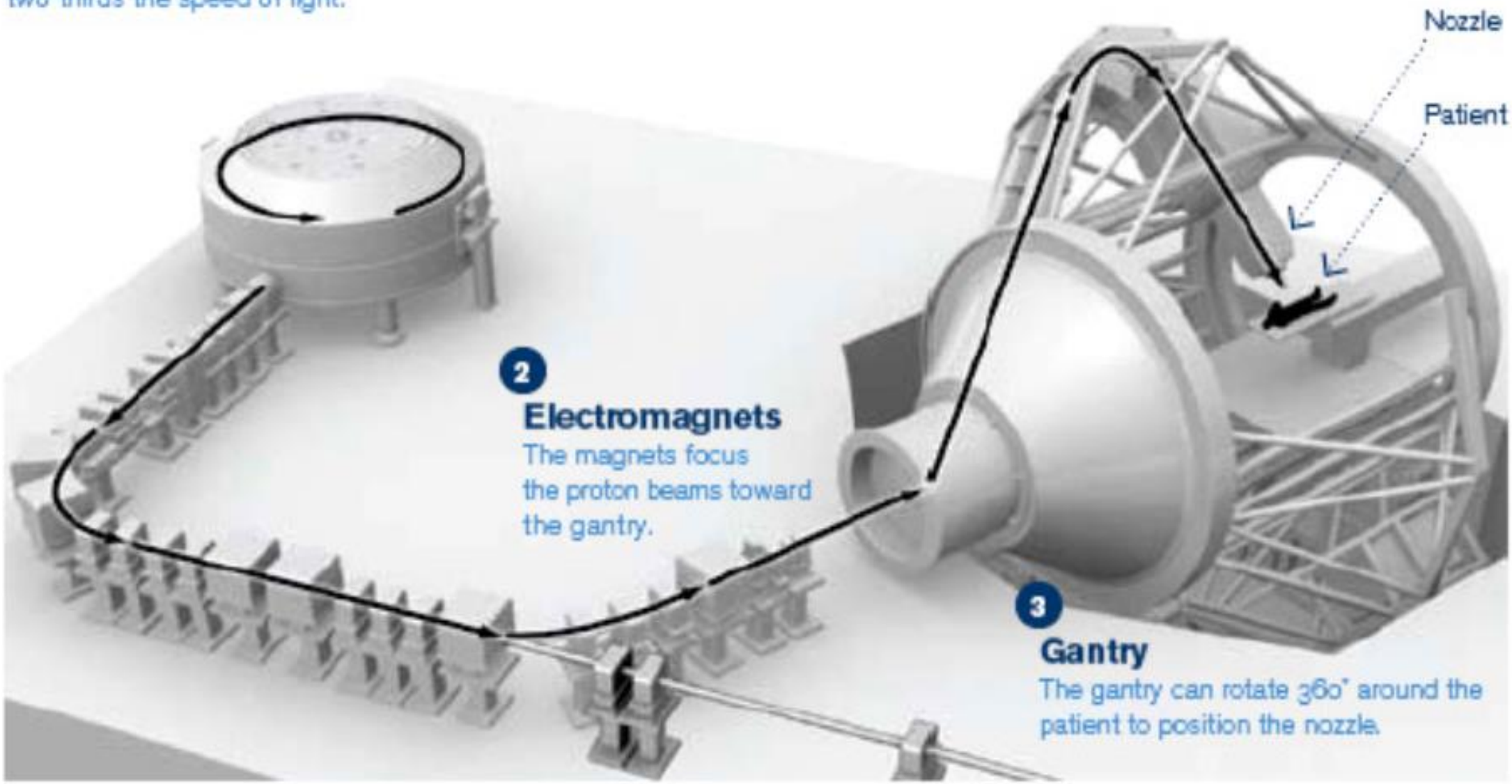
Cyclotron

Using magnetic fields, the cyclotron can accelerate the hydrogen protons to two-thirds the speed of light.

4

Nozzle

A 21,000-pound magnet guides the beam to the patient through a nozzle.



2

Electromagnets

The magnets focus the proton beams toward the gantry.

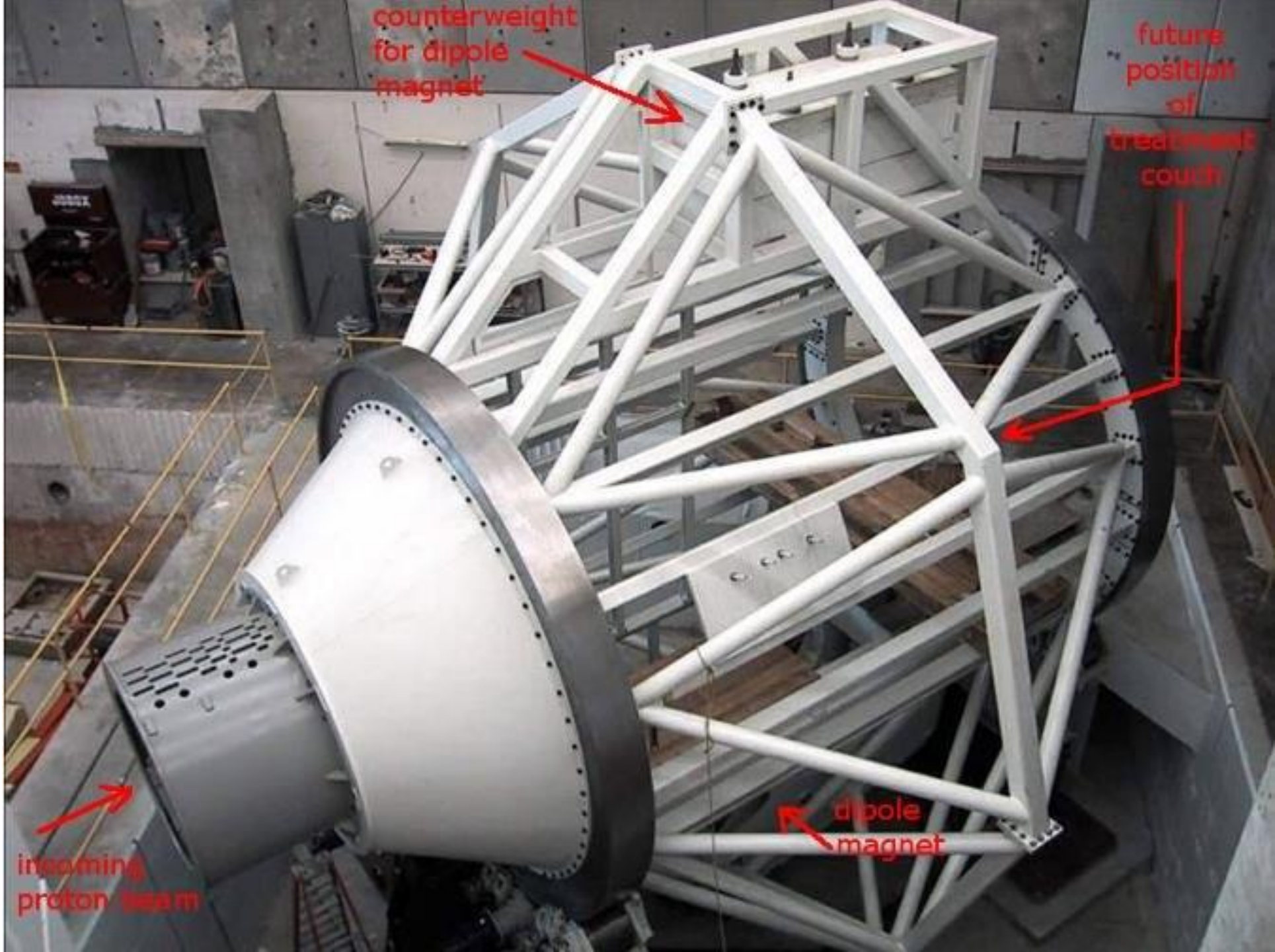
3

Gantry

The gantry can rotate 360° around the patient to position the nozzle.

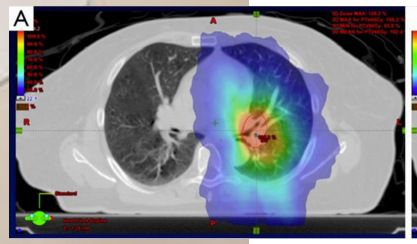
Image: Julie Kramer

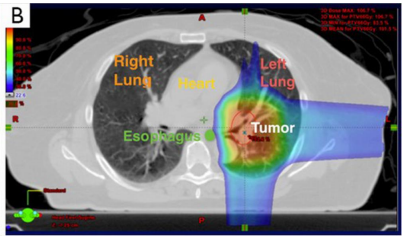
Proton Therapy



直徑近10.2米，總重量140噸

1.必須有 好的固定
2.必須有 精準的治療計畫
3.治療角度較小 轉動速度慢 聲音大 治療時間長



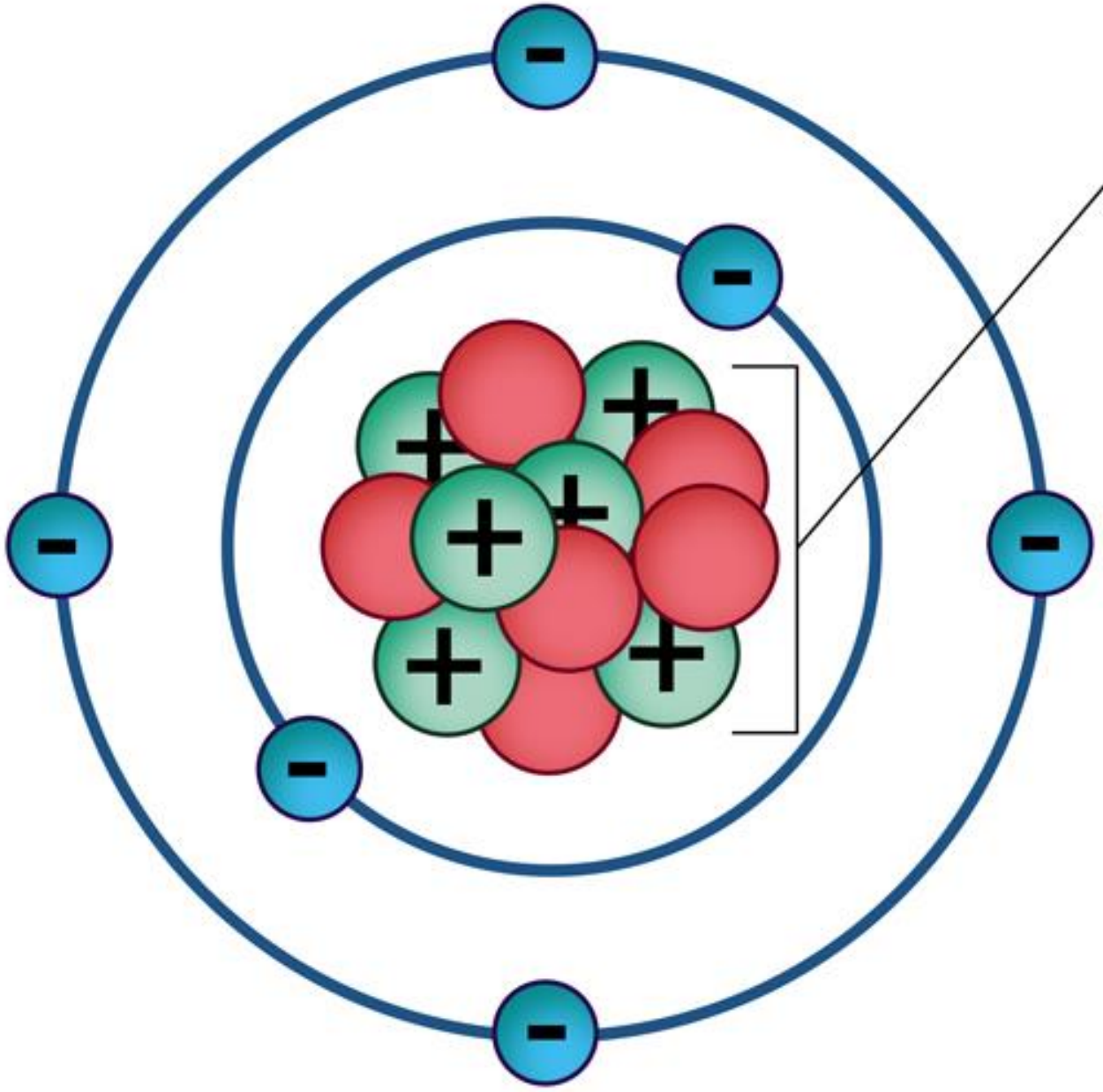


PROTEUS®
ONE


1. Session Definition
2. Beam Selection
3. Preparation
4. Treatment
Prepare equipment
Ready
Ready

PART 03

重粒子治療

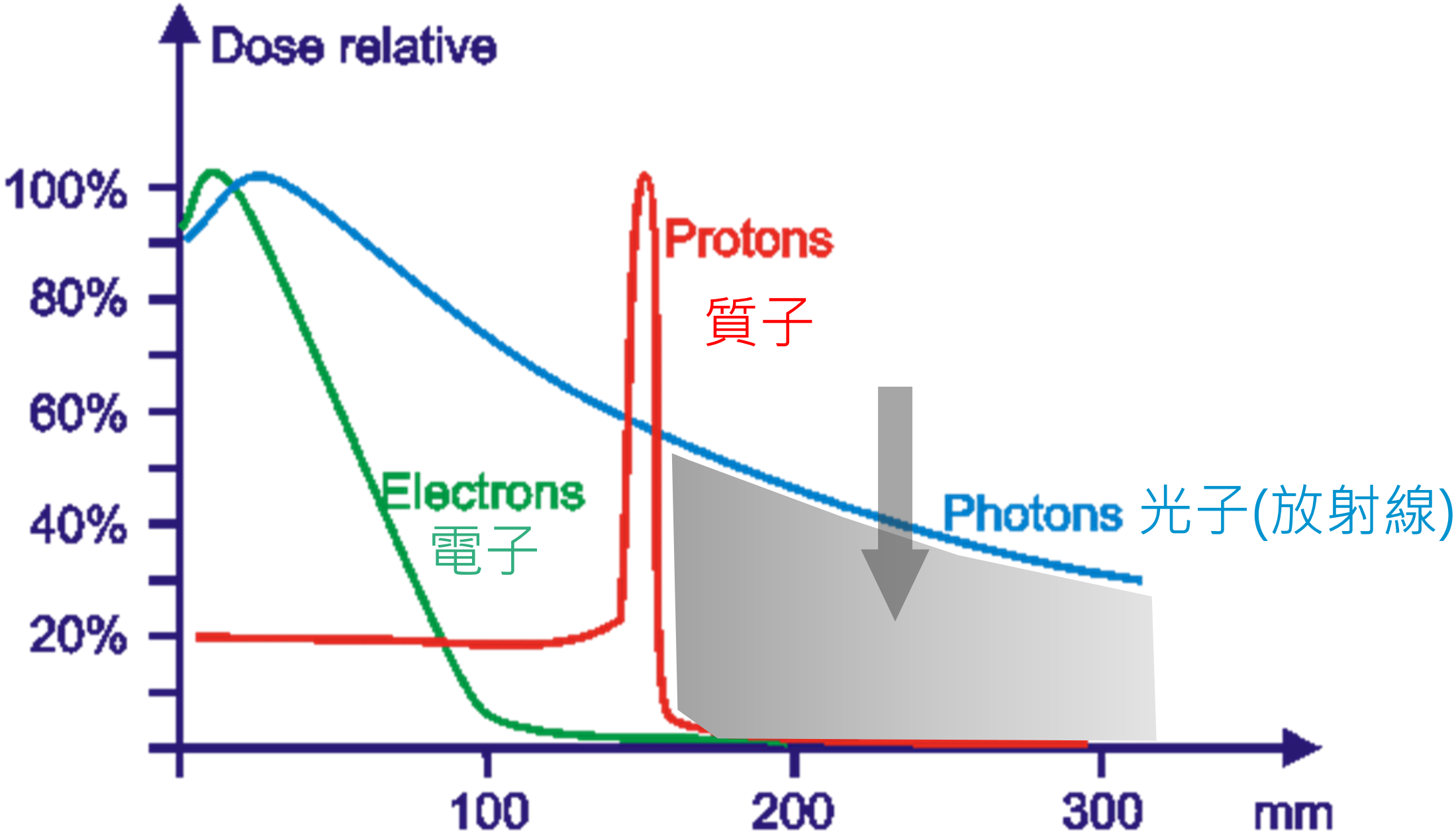


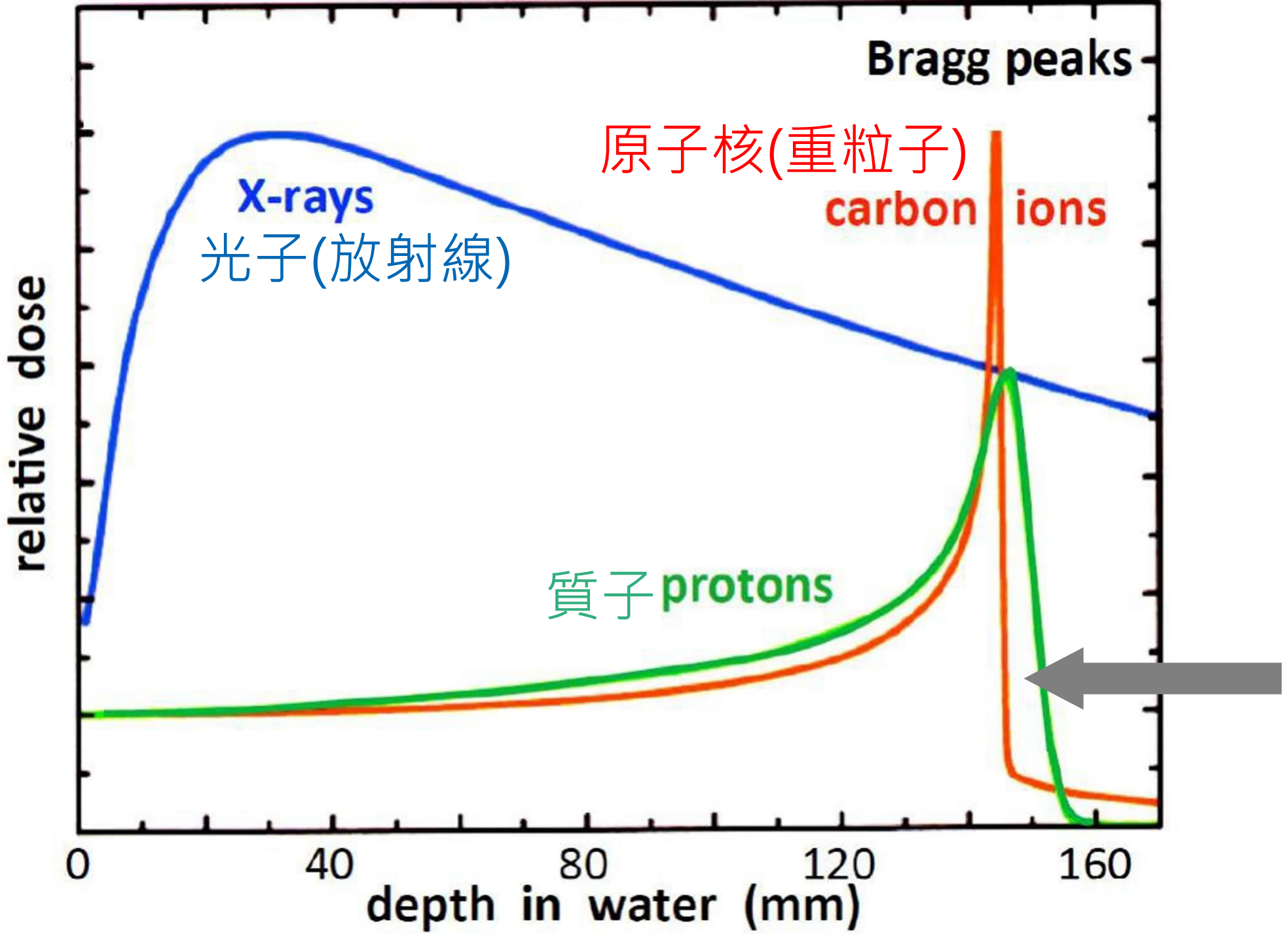
Nucleus
原子核(重粒子)

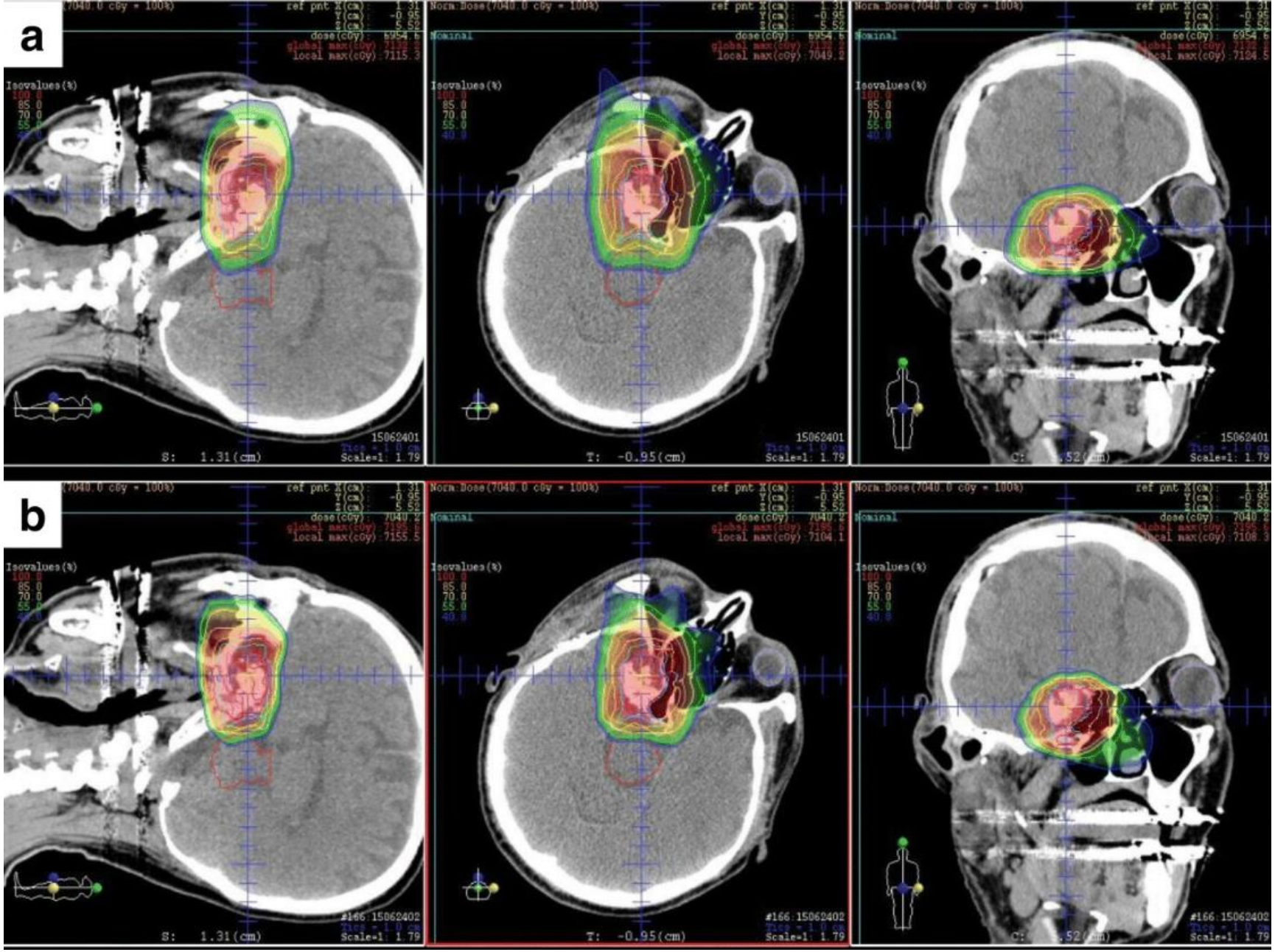
Neutron 中子 1839

Proton 質子 1836

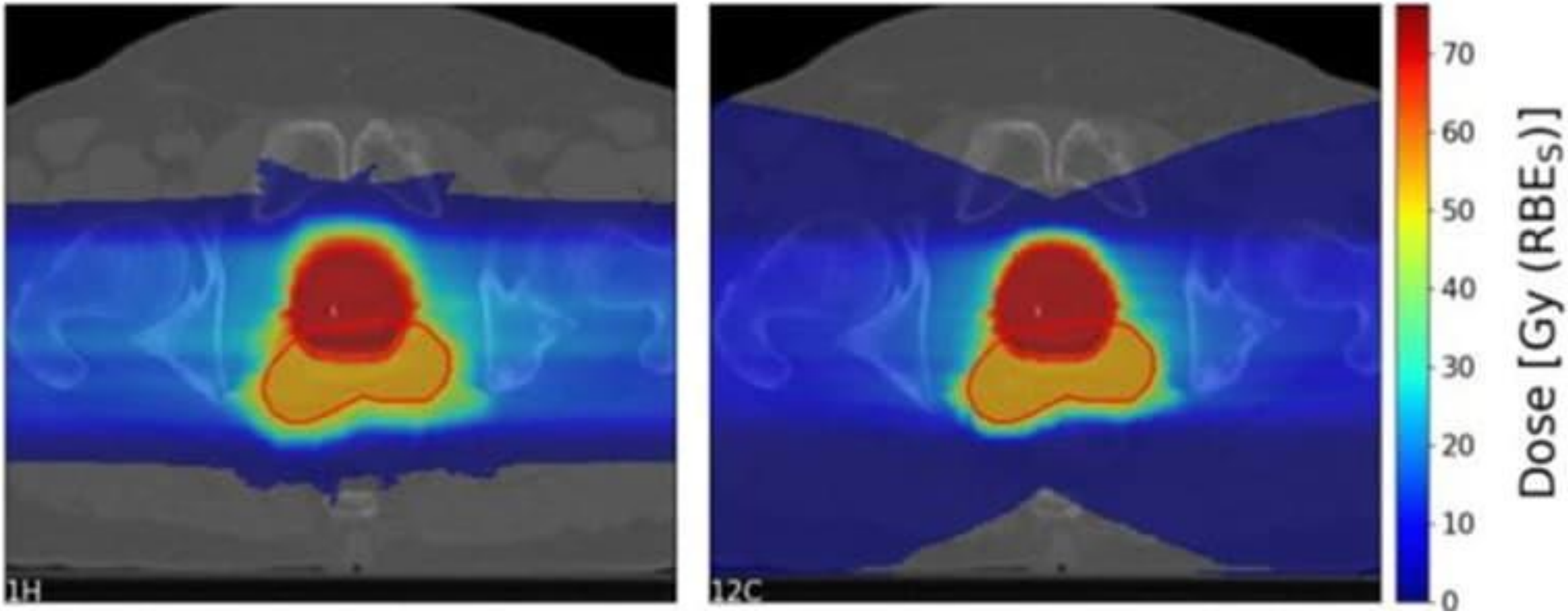
Electron 電子 1

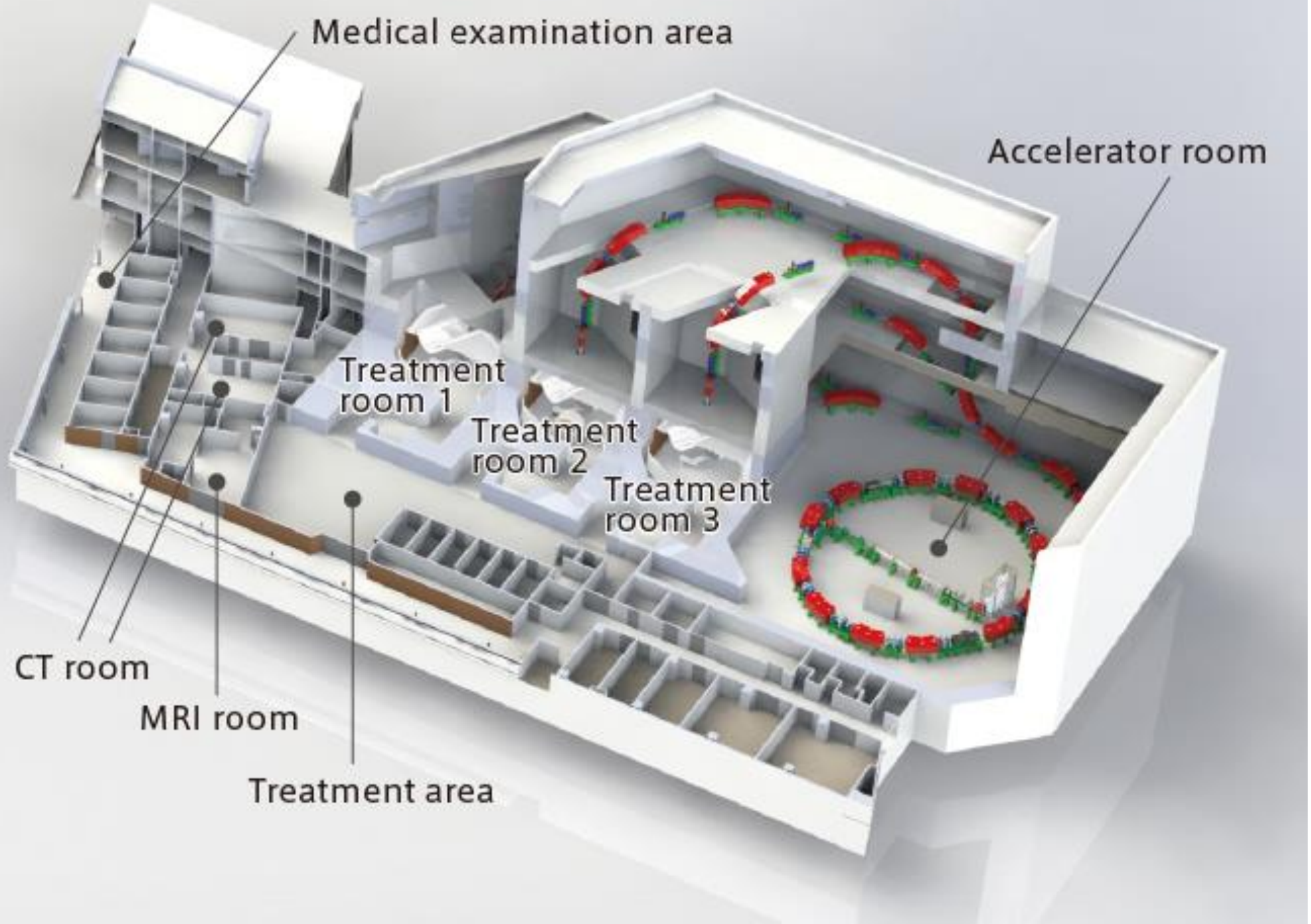

Dose relative
100%
80%
60%
40%
20%
Protons
質子
Electrons
電子
Photons 光子(放射線)
100
200
300
mm


Bragg peaks
原子核(重粒子)
carbon ions
X-rays
光子(放射線)
質子protons
relative dose
0
40
80
120
160
depth in water (mm)



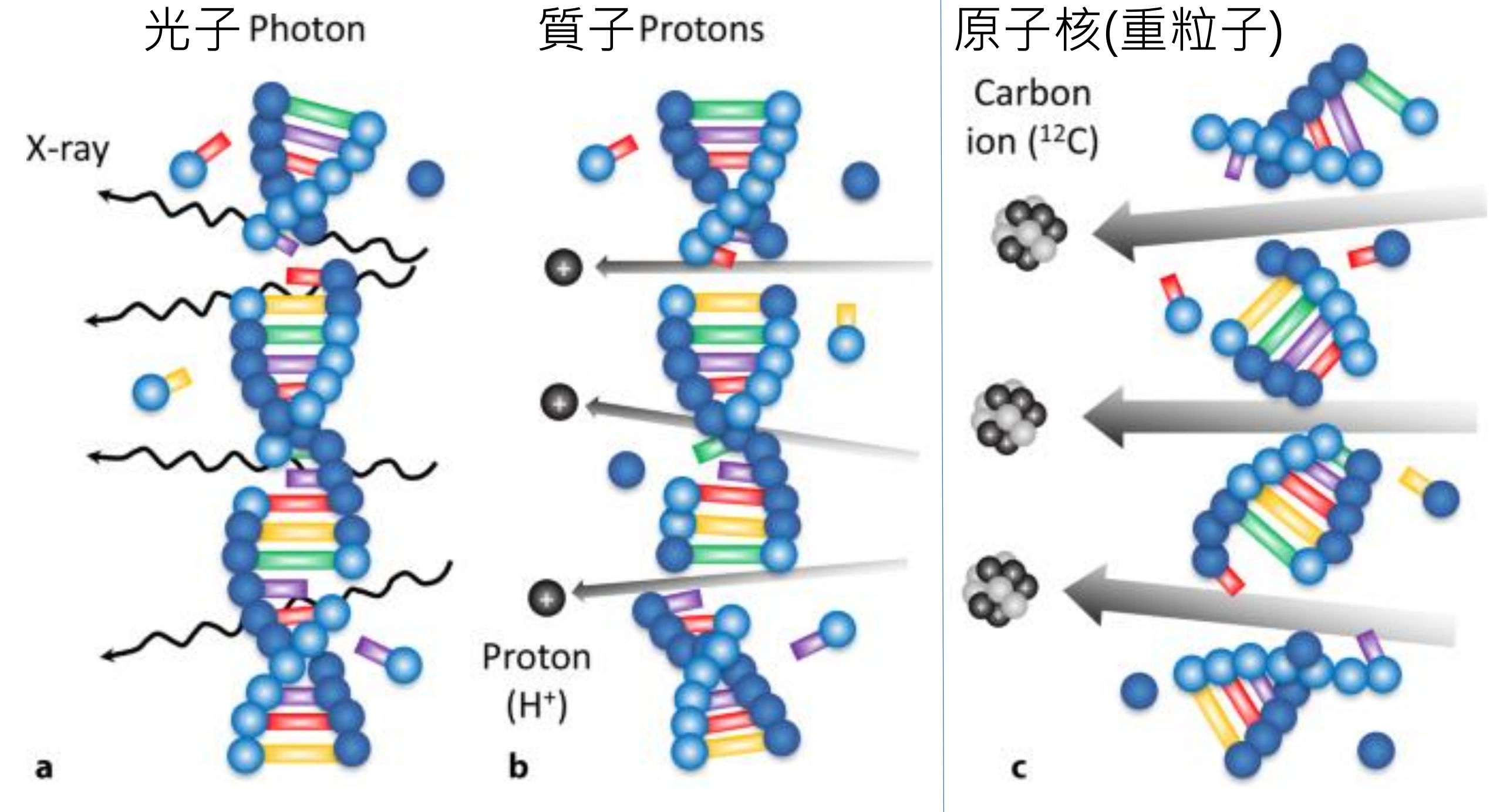
Comparison of proton (**a**) and carbon ion (**b**) treatment plans for the skull base chordomas. In the dose–volume histogram (DVH), the solid and dashed curves represent the carbon ion and proton plans, respectively (**c**)

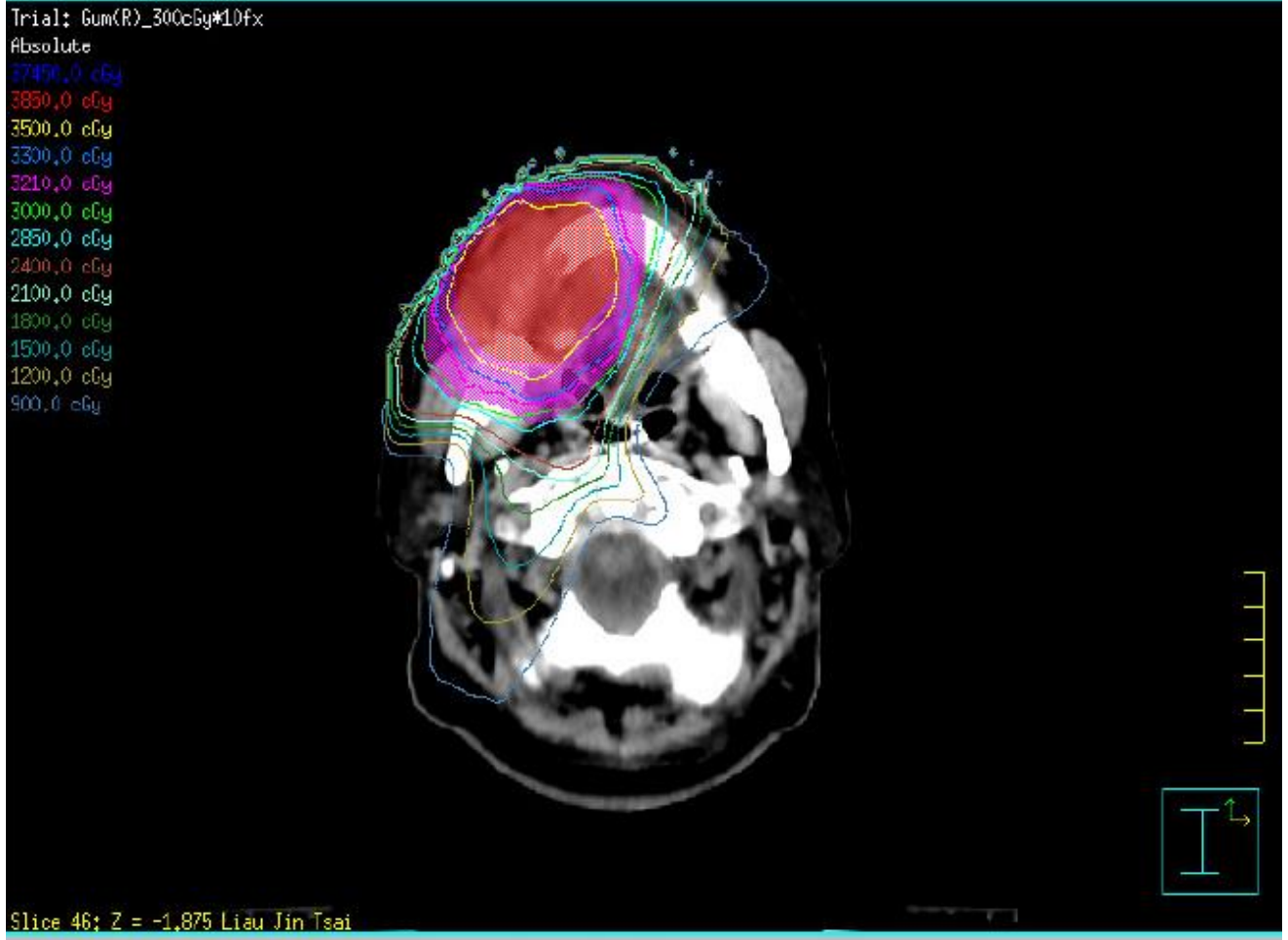

1H
12C
70
60
50
40
30
20
10
0
Dose [Gy (RBEs)]

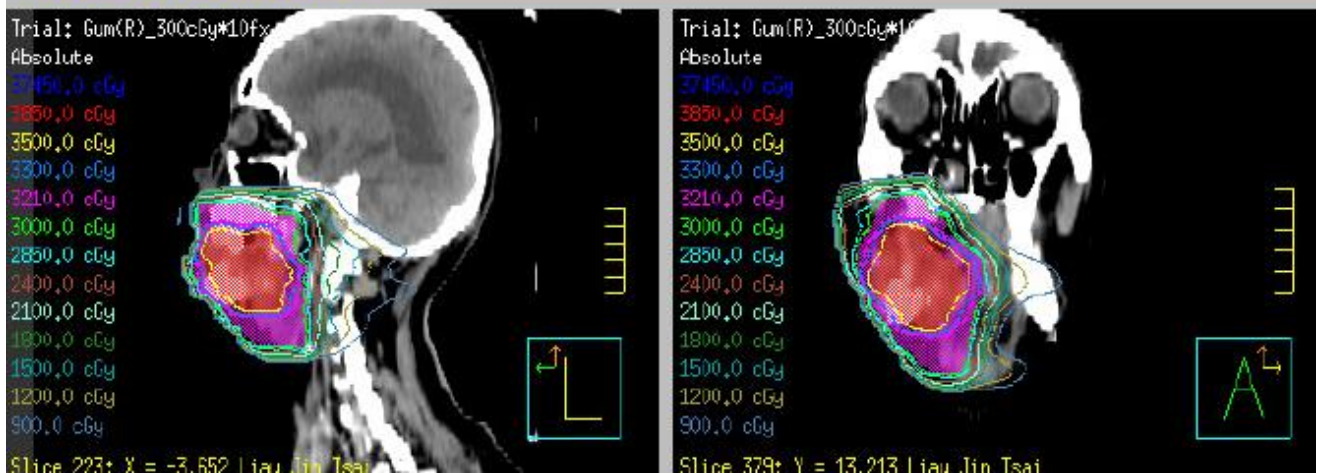

Medical examination area
Accelerator room
Treatment room 1
Treatment room 2
Treatment room 3
CT room
MRI room
Treatment area

Heavy-ion Therapy System HyBEAT *2

1.必須有 好的固定
2.必須有 精準的治療計畫
3.治療角度更小 轉動速度更慢
4.DNA破壞可能是附加的好處 (治療次數可能可以變少)


光子 Photon
質子 Protons
原子核(重粒子)
X-ray
Proton
(H+)
Carbon
ion (12C)
a
b
c





光子與電子層級的放射治療
無法被取代:

靈活度高 治療時間短成本低(健保給付)

現狀與未來

2023

台北榮總　重粒子癌症治療中心

2015

林口長庚　質子治療中心

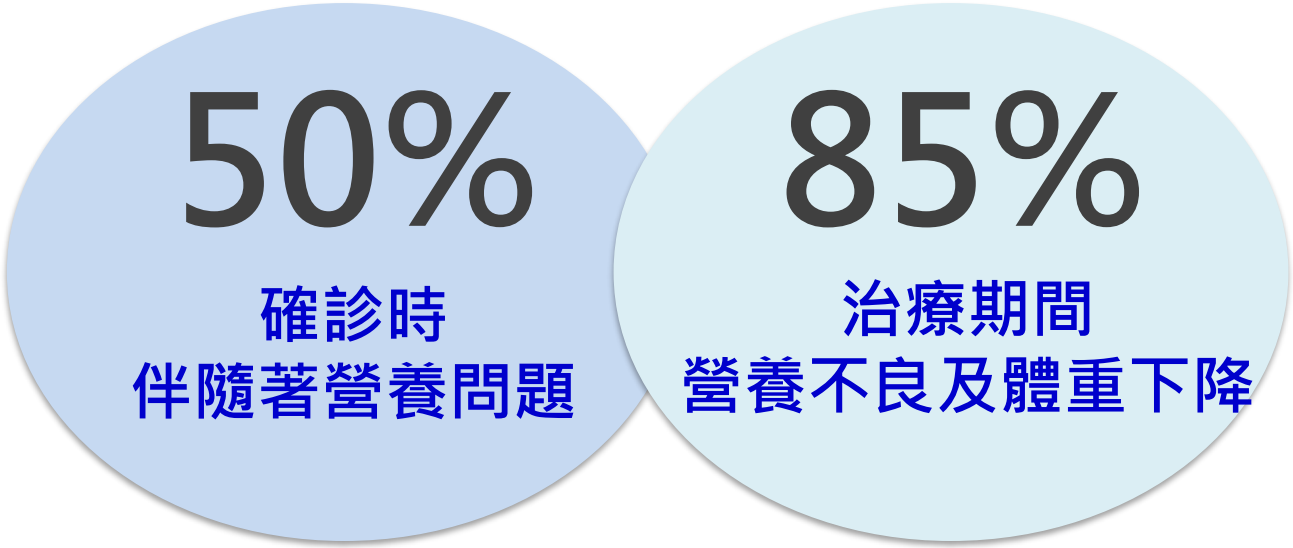
2. 2018 高雄長庚　永慶尖端癌症醫療中心
3. 2022 台北醫學大學　北醫質子中心
4. 2023 中國醫藥大學　質子醫學中心
   2023 國立台灣大學癌醫分院　質子治療科
5. 2027 彰化基督教醫院/高雄醫學大學

Any question ?

雲林基督教醫院 放射腫瘤科主任
簡佑安醫師

癌症患者的營養支持

癌症病人面臨的營養危機



營養不良是癌症病人最常見的問題

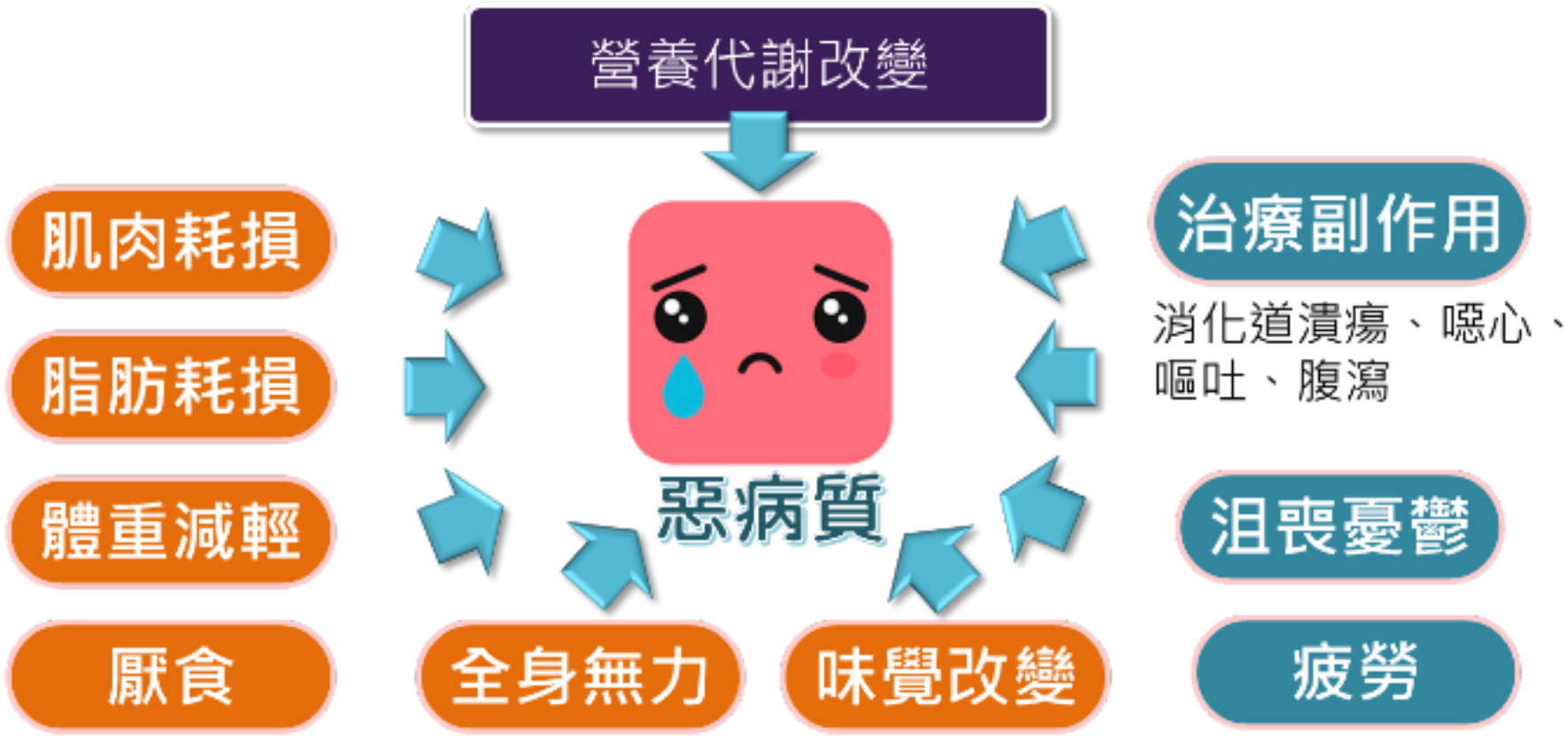
1 *Journal of Cancer* 2019, Vol. 10

癌症病人面臨的營養危機

營養不良可能影響、甚至中斷治療

*癌症營養，臺大醫院營養室。
*Morishita, Int J Phys Med Rehabil 2016, 4:3
*Support Care Cancer. 2016 Jan;24(1):429-35.
J Parenter Enteral Nutr 2014;38(2):196e204.

代謝改變+減少進食 造成惡病質



惡病質的定義及臨床處置

惡病質臨床症狀

- 癌症惡病質重要指標：

  體重、BMI、肌肉耗損情形

- 自我觀察：
  - 量體重：4週內體重急遽減少5%以上
  - 計算BMI：BMI小於20
  - 照鏡子：兩側太陽穴和手掌虎口萎縮情形
  - 日常活動：行動力下降，無法完成日常外出活動

Nature Review Disease Primers 2018;4:17105

肌肉流失的相關的併發症及死亡率

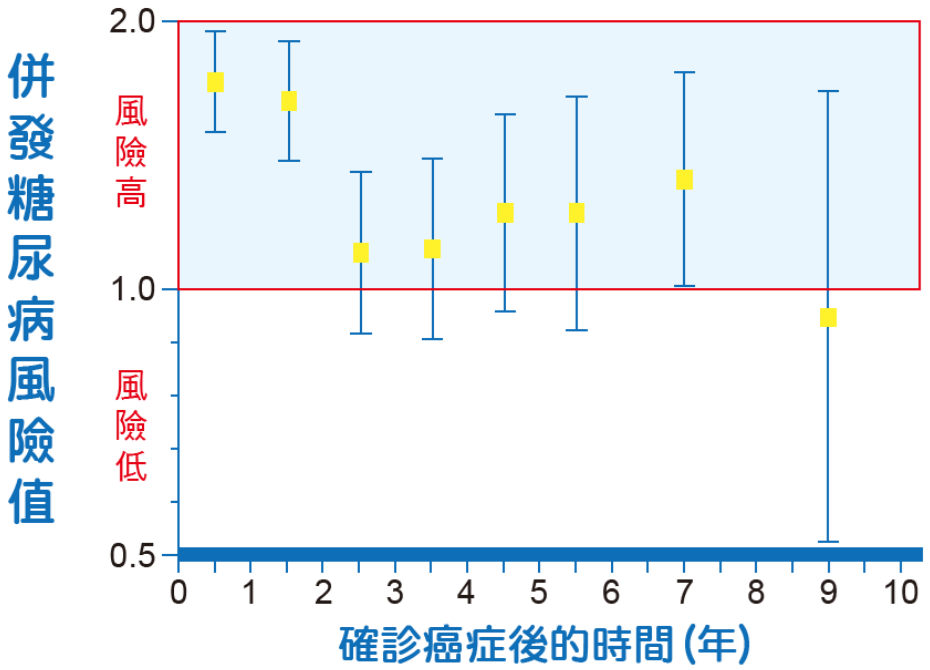
Loss of Total LBM %	Complications	Associated mortality %
10%	Impaired immunity, increased infection	10%
20%	Decreased healing, weakness, infection, thinning of skin	30%
30%	Too weak to sit, pressure sores develop pneumonia, no healing	50%
40%	Death, usually from pneumonia	100%

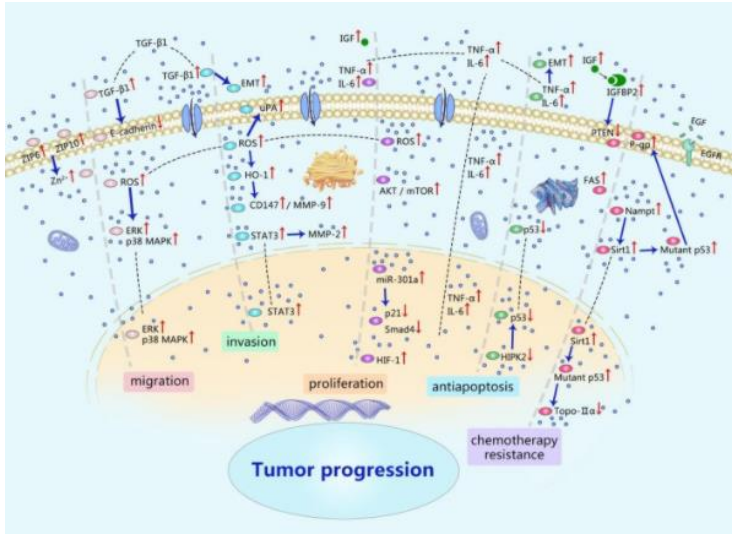
Demling RH. *Eplasty.* 2009;9:65–94

併發血糖異常風險高

罹癌
=>增加血糖異常風險

血糖異常
=>加速癌症進展





Hwangbo, Y., et al. JAMA oncology.2018;4:8,1099-1105

Li W et al. Journal of Experimental & Clinical Cancer Research.2019;38:327

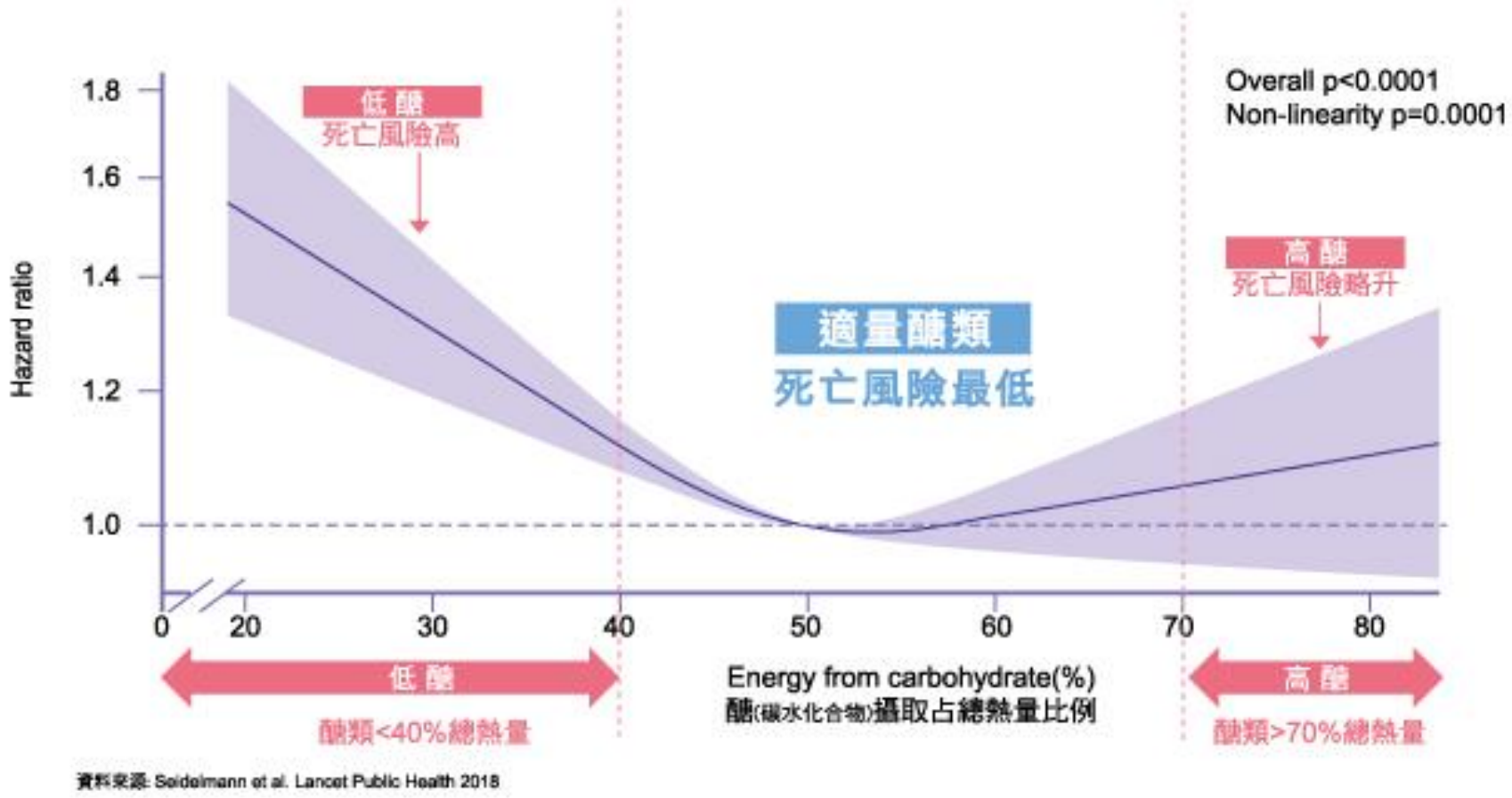
如何對抗惡病質

- 適量醣
- 高蛋白
- 優脂 (Omaga 3)

癌症病人的營養支持

適量醣

補充足夠熱量為病人首要目標



資料來源: Seidelmann et al. Lancet Public Health 2018

- 適量攝取醣類食物
  - 水果類
  - 乳品類
  - 全穀雜糧類，包含米飯、麵食與麵製品、地瓜、 南瓜等根莖類、五穀雜糧

- 適量攝取醣類食物
  - 讓攝取的蛋白質更有效率的合成血球(如紅血球和白血球)、提升免疫力和合成肌肉
  - 葡萄糖也是大腦的主要能量來源
  - 水果類供應微量營養素、膳食纖維和植化素
  - 乳品類供應鈣質、維生素和優良蛋白質

精緻糖

- 造成高血脂、高血糖
- 影響血管健康，增加身體發炎反應

- 每日飲食添加糖攝取量不超過總攝取熱量的10%
- 添加糖是指在製造或製備食物與飲料時額外添加的糖，
  包括黑糖、蔗糖、糖霜、葡萄糖、砂糖、白糖、玉米糖漿、蜂蜜、楓糖漿

癌症病人的營養支持

高蛋白

- 攝取足量蛋白質
  幫助維持白血球和肌肉量

乳清蛋白提升化療中且營養不良的晚期癌症患者體重、肌力，降低毒性反應

TABLE 2 Effect of supplementation with whey protein on body composition, body weight, muscle strength, and quality of life in the modified intention-to-treat population (changes from baseline values)

	First follow-up visit (1 mo)				End of study (3 mo)			
Endpoint	Counseling (N = 76) Mean (SD)	Counseling + whey protein (N = 75) Mean (SD)	Treatment effect Mean (95% CI)	*P*-value	Counseling (N = 69) Mean (SD)	Counseling + whey protein (N = 66) Mean (SD)	Treatment effect Mean (95% CI)	*P*-value
Phase angle (°)	−0.22 (1.23)	0.20 (1.14)	0.42 (0.04 to 0.80)	**.031**	−0.28 (1.18)	0.20 (1.29)	0.48 (0.05 to 0.90)	**.027**
Standardized phase angle	−0.39 (1.70)	0.39 (1.59)	0.78 (0.25 to 1.31)	**.004**	−0.36 (1.55)	0.33 (1.86)	0.69 (0.11 to 1.27)	**.021**
Fat-free mass index (kg/m^2)	−0.01 (1.26)	0.11 (1.17)	0.12 (−0.27 to 0.51)	.53	−0.14 (1.35)	0.32 (1.22)	0.46 (0.02 to 0.90)	**.041**
Body weight (kg)	−0.1 (2.3)	0.3 (2.3)	0.4 (−0.3 to 1.2)	.22	−0.7 (4.2)	1.0 (4.1)	1.7 (0.2 to 3.1)	**.023**
Handgrip strength (kg)	−0.4 (2.9)	0.3 (2.8)	0.7 (−0.2 to 1.6)	.12	−0.9 (4.4)	1.4 (3.1)	2.3 (1.0 to 3.6)	**<.001**
Global QoL [a] (score)	—	—	—	—	0.54 (16.5)	2.94 (13.3)	2.40 (−2.71 to 7.51)	.35

P-values <.05 have been highlighted in bold.

Abbreviations: 95% CI, 95% confidence interval; QoL, quality of life; SD, standard deviation.

[a]Assessed by means of the European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire Core 30 (EORTC-QLQ-C30).

Cancer Medicine. 2019;00:1–10

乳清蛋白提升化療中且營養不良的晚期癌症患者體重、肌力，降低毒性反應

TABLE 3 Treatment toxicity according to CTCAE 4.03 in the randomized population

Endpoints	Primary analysis				Sensitivity analysis[a]			
	Counseling (N = 84) n [%]	Counseling + whey protein (N = 82) n [%]	Risk difference % (95% CI)	*P* value	Counseling (N = 58) n [%]	Counseling + whey protein (N = 54) n [%]	Risk difference % (95% CI)	*P* value
Any	83 [98.8]	73 [89.0]	−9.8 (−16.9 to −2.6)	**.009**	57 [98.3]	48 [88.9]	−9.3 (−18.4 to −0.4)	.055
Hematological[b]	17 [20.2]	10 [12.2]	−8.0 (−19.3 to 3.2)	.21	14 [24.1]	4 [7.4]	−16.7 (−29.8 to −3.7)	**.020**
Gastrointestinalc	44 [52.4]	38 [46.3]	−6.0 (−21.2 to 9.2)	.44	29 [50.0]	24 [44.4]	−5.6 (−24.1 to 12.9)	.58
Others	64 [76.2]	57 [69.5]	−6.7 (−20.2 to 6.8)	.38	41 [70.7]	39 [72.2]	1.5 (−15.2 to 18.3	>.99
Multiple	41 [48.8]	23 [28.0]	−20.8 (−35.2 to −6.3)	**.007**	26 [44.8]	13 [24.1]	−20.7 (−37.9 to −3.6)	**.029**
Grade 3-4	44 [52.4]	18 [22.0]	−30.4 (−44.4 to −16.5)	**.001**	33 [56.9]	10 [18.5]	−38.4 (−54.8 to −21.9)	**<.001**
Hematological[b,d]	12 [14.3]	4 [4.9]	−9.4 (−18.4 to −0.4)	.06	10 [17.2]	1 [1.9]	−15.4 (−25.8 to −5.0)	**.009**
Gastrointestinal[c,d]	21 [25.0]	10 [12.2]	−12.8 (−24.7 to −0.9)	**.046**	18 [31.0]	6 [11.1]	−19.9 (−34.5 to −5.4)	**.012**
Others[d]	11 [13.1]	4 [4.9]	−8.2 (−16.9 to 0.5)	.10	5 [8.6]	3 [5.6]	−3.1 (−12.6 to 6.5)	.72
Grade 5	2 [2.4]	1 [1.2]	−1.2 (−5.2 to 2.9)	>.99	1 [1.7]	0 [0]	−1.7 (−5.2 to 1.8)	>.99
Complete CT suspension	10 [11.9]	5 [6.1]	−5.8 (−14.5 to 2.9)	.28	3 [5.2]	2 [3.7]	−1.5 (−9.1 to 6.2)	>.99

P-values <.05 have been highlighted in bold.

Abbreviations: 95% CI, 95% confidence interval; CT, chemotherapy.

[a]Patients receiving at least three CT cycles during the study.

[b]Neutropenia/anaemia/thrombocytopenia.

[c]Nausea/vomiting/diarrhea/constipation.

[d]Only the worst was counted for each patient.

Cancer Medicine. 2019;00:1–10

直腸癌患者術前補充乳清蛋白可改善功能步行能力

Prehabilitation with Whey Protein Supplementation on Perioperative Functional Exercise Capacity in Patients Undergoing Colorectal Resection for Cancer: A Pilot Double-Blinded Randomized Placebo-Controlled Trial

Chelsia Gillis, MSc, RD*; Sarah-Eve Loiselle, PDt‡; Julio F. Fiore, Jr, PhD, PT; Rashami Awasthi; Linda Wykes, PhD; A. Sender Liberman, MD; Barry Stein, MD; Patrick Charlebois, MD; Francesco Carli, MD, MPhil

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‡Professional dietitian certified in Q
(equivalent to RD).

ABSTRACT

Background A previous comprehensive prehabilitation program, providing nutrition counseling with whey protein supplementation, exercise, and psychological care, initiated 4 weeks before colorectal surgery for cancer, improved functional capacity before surgery and accelerated functional recovery. Those receiving standard of care deteriorated. The specific role of nutritional prehabilitation alone on functional recovery is unknown.

Objective This study was undertaken to estimate the impact of nutrition counseling with whey protein on preoperative functional walking capacity and recovery in patients undergoing colorectal resection for cancer.

Design We conducted a double-blinded randomized controlled trial at a single university-affiliated tertiary center located in Montreal, Quebec, Canada. Colon cancer patients (n=48) awaiting elective surgery for nonmetastatic disease were randomized to receive either individualized nutrition counseling with whey protein supplementa-

Conclusion Clinically meaningful improvements in functional walking capacity were achieved before surgery with whey protein supplementation. These pilot results are encouraging and justify larger-scale trials to define the specific role of nutrition prehabilitation on functional recovery after surgery.

were similar between groups (P=0.81).

Conclusion Clinically meaningful improvements in functional walking capacity were achieved before surgery with whey protein supplementation. These pilot results are encouraging and justify larger-scale trials to define the specific role of nutrition prehabilitation on functional recovery after surgery.
J Acad Nutr Diet. 2016;116:802-812.

J Acad Nutr Diet. 2016;116:802-812.

BCAA提高肝癌患者存活率、白蛋白

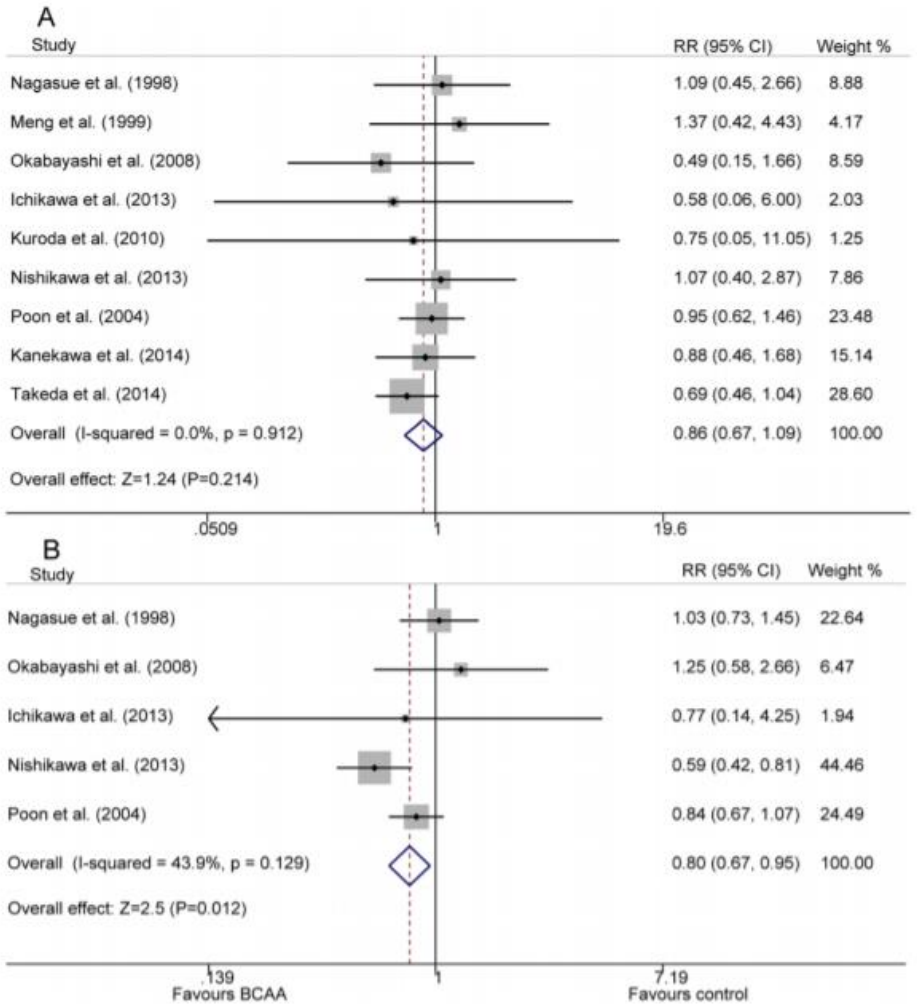


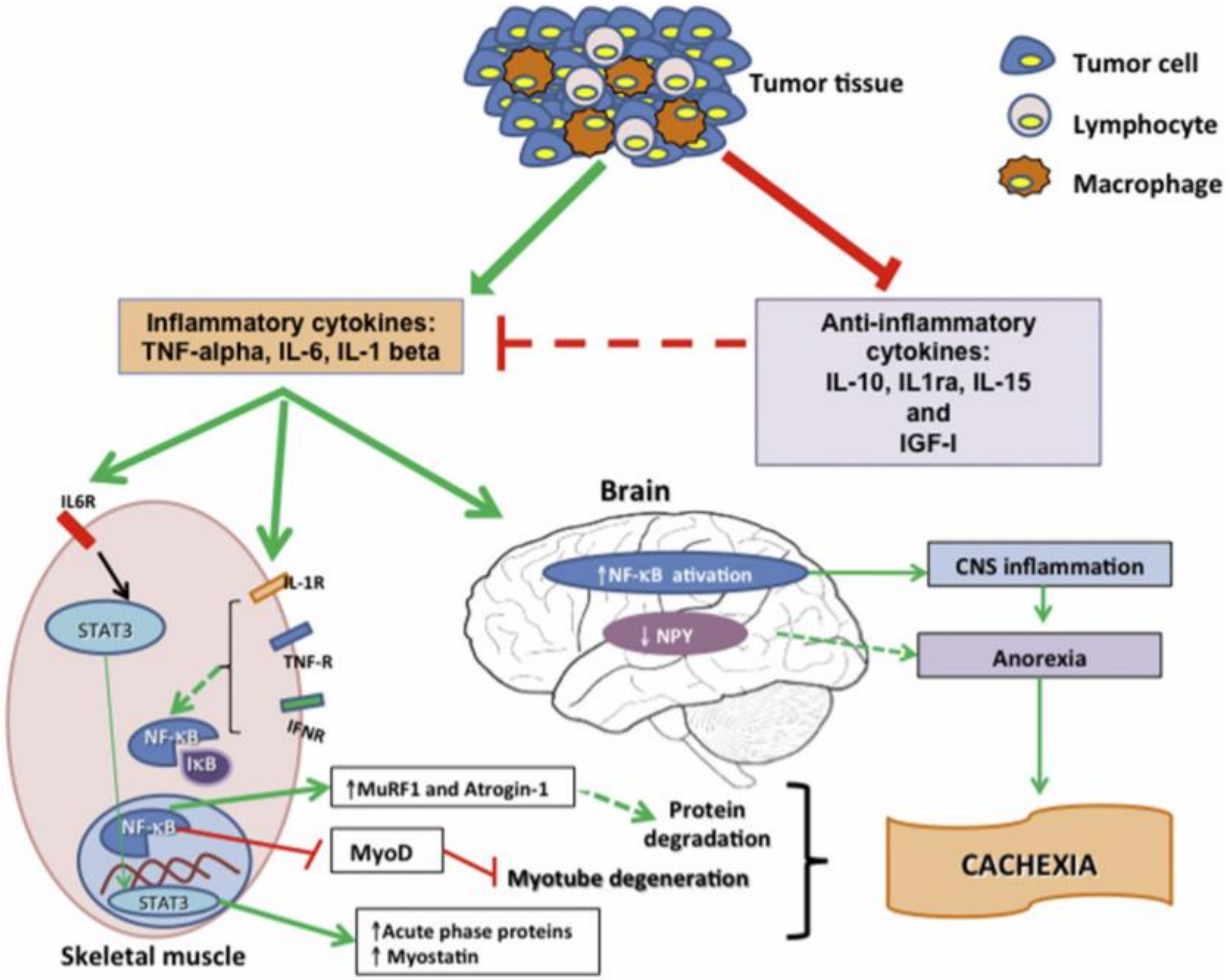
Fig. 2 Forest map of summary estimates for comparison of mortality between BCAA and control groups. **a**) 1-year mortality; **b**) 3-year mortality

Chen et al. Nutrition Journal (2015) 14:67

癌症病人的營養支持

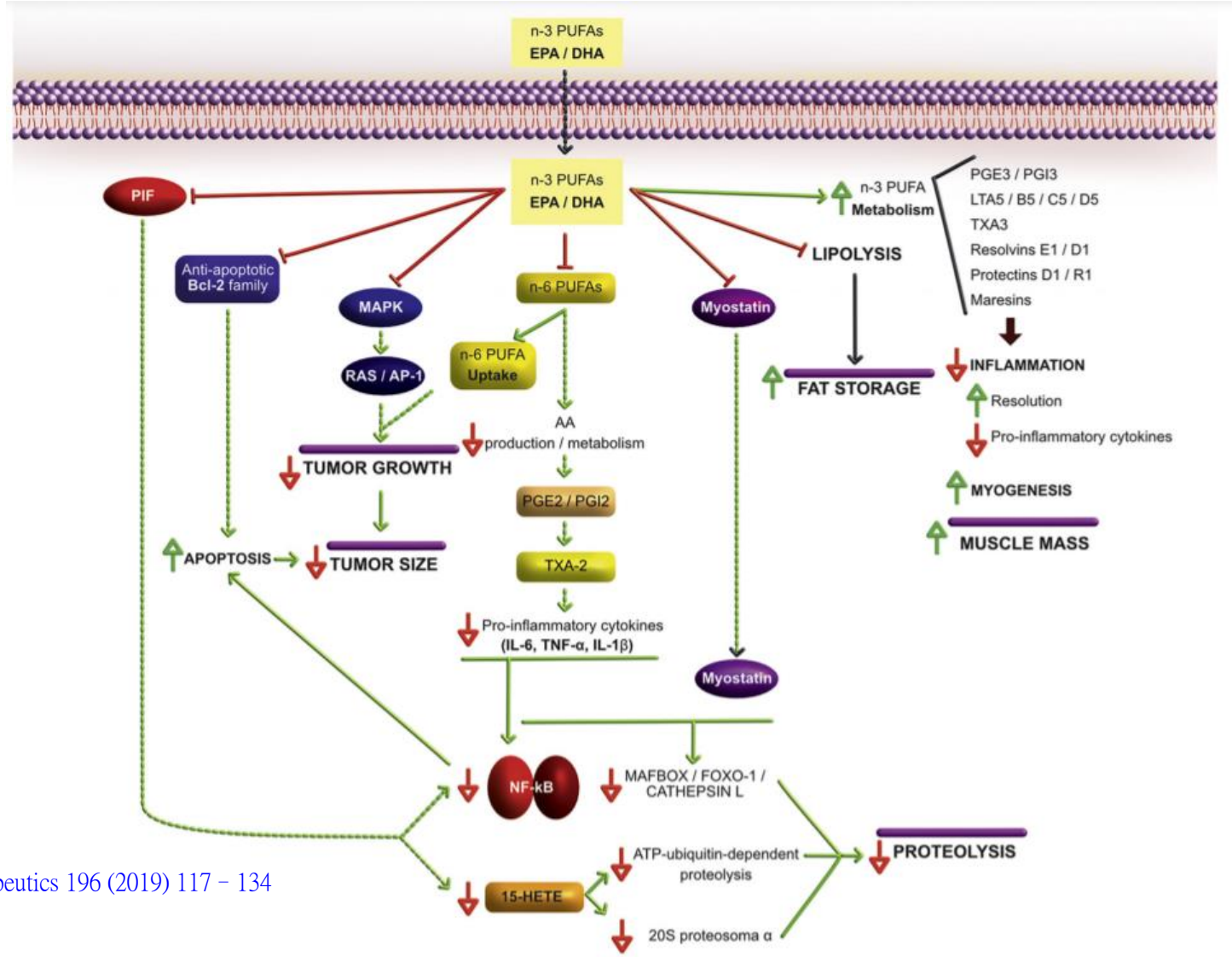
優脂

Omega-3 減少癌症病人發炎反應



Pharmacology & Therapeutics 196 (2019) 117 – 134

Omega-3 減少癌症病人發炎反應



Pharmacology & Therapeutics 196 (2019) 117 – 134

Omega-3 Fatty Acid Acting on Different Elements of the Viral Immune Response

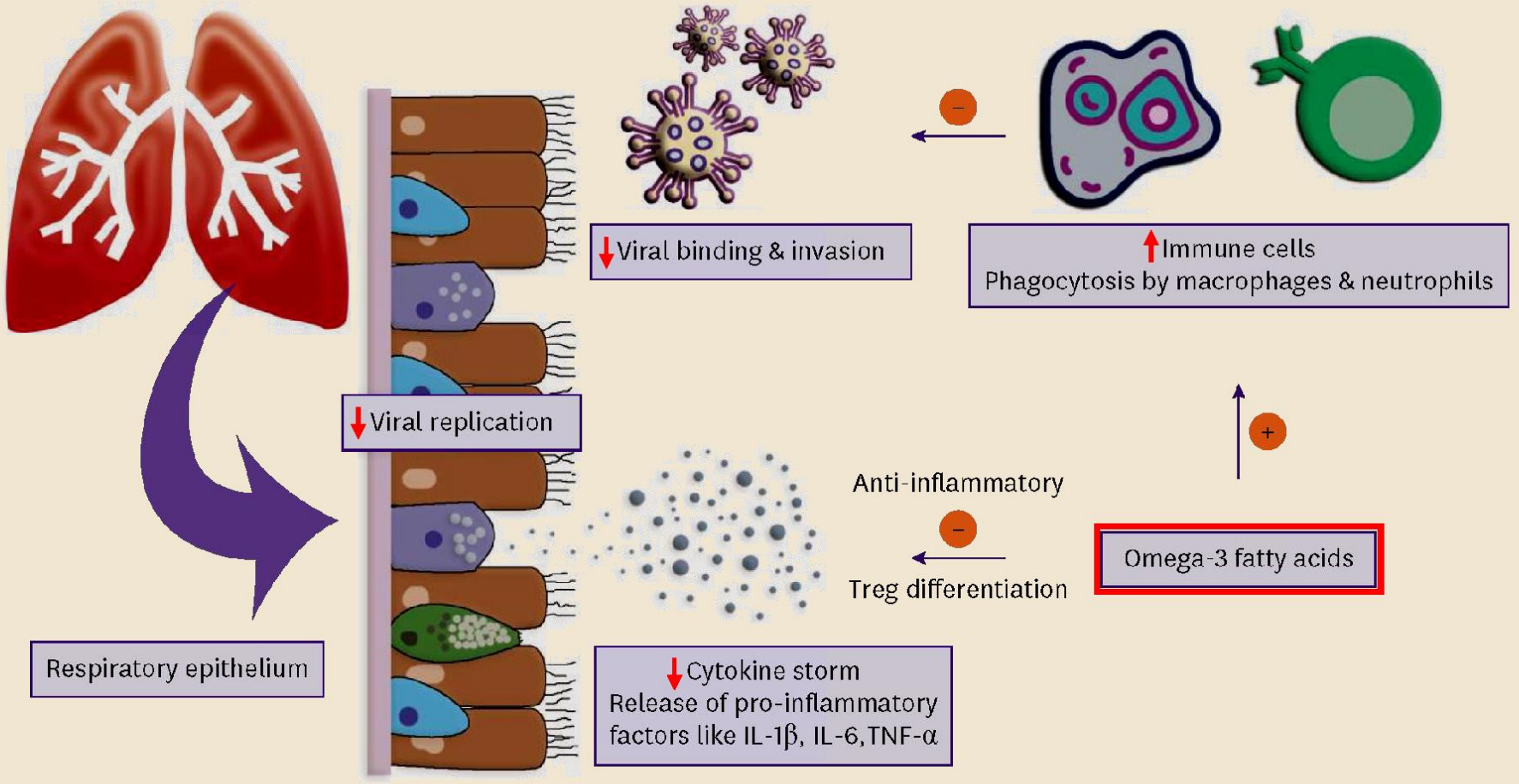


Chart Date 1/4/21

Hathaway et al., *Infect Chemother.*, 2020.

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Omega-3 減少癌症相關併發症(抑鬱)

Table 3. A brief summary of the selected articles using omega-3 PUFAs as treatment for depression.

Authors	Clinical or Experimental Condition	Species	Treatment Scheme	Major Outcome
Chhetry et al, 2016 [143]	MDD	Human	4 g [1] FO (1.6 g EPA + 0.8 g DHA)	Improved MDD-related white matter deficiency
Smith et al., 2017 [129]	MDD	Human	260 mg or 520 mg DHA	54% of patients showed a reduction of depression severity ≥ 50%
Wu et al., 2018 [144]	Chemotherapy-induced depression	Rat	1.5 g/kg omega-3 PUFAs (34% EPA + 24% DHA)	PUFAs inhibited depressive-like behaviors ($p < 0.001$)
Dang et al., 2018 [133]	LPS-induced depression	Rat	1.5 g/kg omega-3 PUFAs (34% EPA + 24% DHA)	Omega-3 PUFAs decreased depressive behavior ($p < 0.001$)
Nishinaka et al., 2014 [137]	Behavioral despair paradigm	Mice	GW9508 (1.0, 10 or 25 µg/mouse) i.c.v	FFA1 activation decreased immobility in a tail suspension test ($p < 0.05$)
Deyama et al., 2017 [140]	LPS-induced depression	Mice	RvD1 (10 ng i.c.v.) or RvD2 (10 ng i.c.v.)	Both treatments inhibited depressive-like behaviors ($p < 0.005$)
Deyama et al., 2018 [141]	LPS-induced depression	Mice	RvE3 (10 and 100 ng i.c.v.)	Inhibition of depressive behavior ($p < 0.005$)
Ishikawa et al., 2017 [142]	Chronic unpredictable stress-related depression	Mice	RvD1 (10 ng i.c.v.) or RvD2 (10 ng i.c.v.)	Both treatments inhibited depressive behavior for 24 h ($p < 0.05$)

[1] FO: Fish oil.

Nutrients 2019, 11, 945; doi:10.3390/nu11050945

Omega-3 減少癌症相關併發症(疼痛)

Table 1. A summary of the articles discussed above regarding the effects of omega-3 PUFAs in cancer and cancer-treatment complications.

Authors	Cancer-Related Complication	Species	Cancer Type	Treatment Scheme	Major Outcome
Hershmann et al., 2015 [96]	Aromatase-inhibitor associated arthralgia	Human	Breast cancer	3.3 g [1] FO (560 mg EPA + DHA; 40:20)	Decreased pain, evaluated by the [2] BPI between the baseline and week 24 ($p < 0.01$)
Shen et al., 2018 [97]	Aromatase-inhibitor associated arthralgia	Human	Breast cancer (obese)	3.3 g FO (560 mg EPA + DHA; 40:20)	Pain reduction in [3] BMI > 30 kg/m^2 patients ($p = 0.02$)
Martínez et al., 2018 [98]	Aromatase-inhibitor musculoskeletal symptoms (AIMSS)	Human	Breast cancer	460 mg EPA + DHA 12.5 mg hydroxytyrosol 50 g curcumin	Decrease of the BPI total score after 30 days ($p = 0.011$)
Ghroreishi et al., 2012 [99]	Paclitaxel-induced neuropathy	Human	Breast cancer	640 mg FO (54% DHA + 10% EPA)	70% did not develop neuropathy no pain score assessed
Maschio et al., 2018 [100]	Bortezomib-related neuropathy	Human	Multiple myeloma	Neuronorm® (400 mg DHA + 600 mg ALA)	Pain failed to increase significantly ($p = 0.33$)
Freitas et al., 2016 [11]	Cyclophosphamide-induced hemorrhagic cystitis	Mice	-	20% FO-enriched diet or 1 µmol/kg i.p.	Decrease in spontaneous pain behavior and abdominal allodynia ($p < 0.01$)
Ye et al., 2018 [95]	Oral and paw cancer pain	Mice	Oral squamous cell carcinoma	RvD1 (100 ng or 200 ng) or RvD2 (100 ng or 200 ng) i.p.	RvD2 inhibited thermal and mechanical pain; RvD1 inhibited thermal pain

[1] FO: Fish oil; [2] BPI: Brief pain inventory; [3] BMI: body mass index.

Nutrients 2019, 11, 945; doi:10.3390/nu11050945

omega-3幫助胰臟癌晚期患者提升體重、肌肉量、生活品質

TABLE I
Characteristics of the 11 included trials

Trial	Intervention	Parameters	Outcome	Weight loss before treatment	*n*
Barber et al., 1999 (1)	1.09 g EPA/day	Appetite, BW, DI, KPS, LBM, REE, TEI OS	APPR was stable; significant weight gain at both 3 and 7 wk; dietary intake increased significantly; REE/kg and REE/LBM decreased significantly; KPS and appetite were significantly improved at 3 wk	2.4 Kg/m	20
Bauer et al., 2005 (3)	1.5 cans	BW, DI, LBM, QOL	Significant improvement in total dietary intake and BW over the 4–8 wk; LBM was stable	3.3 Kg/m	200
Moses et al., 2004 (4)	1.1 g EPA/day	BW, DI, LBM, QOL, REE	No change in weight, LBM or REE over the 8-wk period of supplementation; significant improvement in QoL	19%	24
Fearon et al., 2003 (6)	2.2 g EPA/day	BW, LBM, QOL	Significant weight gain; LBM gain; significant improvement in QoL	3.3 Kg/m	200
Barber et al., 1999 (1)	2g EPA/day + 1 g DHA/day	APPR, BW	APPR was stable	17.90%	36
Wigmore et al., 2000 (7)	EPA: 1–6 g/day over 4 wk	APPR, BW, KPS, LBM, PFAA, TA	Stabilization of BW over 3–12 wk; APPR was stable, KPS	2 Kg/m	26
Barber et al., 2001 (8)	2.2 g EPA/day + 0.96 g DHA/day	BW, IL-6, TNF-α, PIF	Significant decrease in IL-6 and PIF; significant BW gain over 3 wk; serum TNF-α was stable	2.9 Kg/m	20
Wigmore et al., 1996 (9)	1 g fish oil (EPA 18%, DHA 12%)	APPR, BW, REE	Significant weight gain; REE was stable; significant decrease in APPR	2.9 Kg/m	18
Giovanni Mantovani et al., 2010	2.2 g EPA/day	IL-6, LBM, REE, et al.	Significant increase in BW and LBM; significant decrease in REE/kg and REE/LBM over 3 wk; significant increase in serum insulin	>10%	16
Barber et al., 2000	2 g EPA/day	BW, LBM, APPR, REE/kg, REE/LBM	APPR and REE were stable	2.9 Kg/m	16
Zuijdgeest-Vanleeuwen et al., 2000	6 g EPA/day	APPR, BW, REE	Stabilization of BW over 3–12 wk; APPR was stable, KPS	>10%	17

EPA = eicosapentaenoic acid; APPR = acute-phase protein response; BW = body weight; DI = dietary intake; KPS = Karnofsky performance status; LBM = lean body mass; PFAA = plasma fatty acid analysis; QOL = quality of life; TA = toxicity assessment includes full blood count, electrolytes, urea, glucose, and liver function tests; REE = resting energy expenditure; PI = proteolysis inducing factor; WL = weight loss.

n-3 PUFAs are effective anticachectic agents:

↑ weight gain
↑ dietary intake
↑ lean body mass
↑ quality of life
↓ resting energy expenditure
↓ acute-phase protein response

Nutrition and Cancer, 67(1), 112 – 118

omega-3幫助胰臟癌晚期患者提升存活時間

TABLE 2
Consumption ofan oral nutrition supplement enriched with n-3 PUFAs: Overall survival

Trial	n-3PUFA treatment group	Control group
Barber et al., 1999 (1)	170 days	63–122 days
Moses et al., 2004 (4)	130 days	128 days
Fearon et al., 2003	142 days	128 days
Barber et al., 2001 (8)	191 days	130 days
Davidson et al., 2004	164–259 days	130 days
Wigmore et al., 2000 (7)	173 days	123 days
Fearon et al., 2006	155 days	130 days

n-3 PFUAs = omega-3 polyunsaturated fatty acids; OS = overall survival defined as the time from enrollment of the n-3PUFA treatment group to death.

Nutrition and Cancer, 67(1), 112 – 118

素食人口omega-3缺乏狀況

- 素食主義者血液中Omega-3含量比食用海產者低至少60%

J Hum Nutr Diet. 30, 693 – 699 doi: 10.1111/jhn.12474

Table 5
Comparison of red blood cell EPA + DHA (percent of total fatty acids) in vegans and controls in previous studies.

Population	Vegans	Controls	Description of controls
British[16]	2.0% ($n = 22$)	6.4% ($n = 22$)	"not on special diets"; matched on age, sex, height, SES status, ethnicity
Austrian[3]	1.0% ($n = 37$)	2.2% ($n = 23$)	Self-defined omnivore by questionnaire
Dutch[17]	2.3% ($n = 12$)	4.5% ($n = 76$)	"adult omnivores"
Finnish[18]	3.8% ($n = 8$)	8.1% ($n = 11$)	"normal mixed diet"; controls reported an average of 2 fish meals per week
US (present study)	3.5% ($n = 40$)	3.5% ($n = 78$)	US Soldiers deployed in Iraq[10]

Clinical Nutrition 34 (2015) 212-218

藻油、魚油 效果相似

Randomized Controlled Trial > J Am Diet Assoc. 2008 Jul;108(7):1204-9.
doi: 10.1016/j.jada.2008.04.020.

Algal-oil capsules and cooked salmon: nutritionally equivalent sources of docosahexaenoic acid

Linda M Arterburn [1], Harry A Oken, Eileen Bailey Hall, Jacqueline Hamersley, Connye N Kuratko, James P Hoffman

Affiliations + expand

PMID: 18589030 DOI: 10.1016/j.jada.2008.04.020

Abstract

Food and nutrition professionals question whether supplement-sourced nutrients appear to be equivalent to those derived from natural food sources. We compared the nutritional availability of docosahexaenoic acid (DHA) from algal-oil capsules to that from assayed cooked salmon in 32 healthy men and women, ages 20 to 65 years, in a randomized, open-label, parallel-group study. In this 2-week study comparing 600 mg DHA/day from algal-oil capsules to that from assayed portions of cooked salmon, mean change from baseline in plasma phospholipids and erythrocyte DHA levels was analyzed and DHA levels were compared by Student's t tests. In post-hoc analyses to determine bioequivalence, least-squares mean ratios of percent change from baseline in plasma phospholipid and erythrocyte DHA levels were compared. DHA levels increased by approximately 80% in plasma phospholipids and by approximately 25% in erythrocytes in both groups. Changes in DHA levels in plasma phospholipids and erythrocytes were similar between groups. As measured by delivery of DHA to both plasma and erythrocytes, fish and algal-oil capsules were equivalent. Both regimens were generally well-tolerated. These results indicate that algal-oil DHA capsules and cooked salmon appear to be bioequivalent in providing DHA to plasma and red blood cells and, accordingly, that algal-oil DHA capsules represent a safe and convenient source of non-fish-derived DHA.

台灣癌症患者 植物來源Omega-3 研究案例

富含 n-3 多元不飽和脂肪酸之藻油補充品對於使用化放療頭頸癌患者之影響—病例報告

邱子涵[1]　蔡宛芮[1]　侯沂錚[1*]

臨床試用報告總結

臨床實證12週，改善營養狀況，增強體力

- **體重、BMI顯著提升，TSF、MAC有上升趨勢**
  →期望延緩癌症患者體重下降、肌肉耗損情形
- **白蛋白、前白蛋白、運鐵蛋白、總蛋白質皆顯著提升**
  →期望改善營養狀況，降低癌症患者惡病質風險
- **握力提升、Hs-CRP/Alb比值降低、 Hs-CRP降低**
  →期望可降低癌症病人死亡率、減緩肌少
- 維持穩定血糖、血脂理想標準；不影響肝腎功能及排便狀況

(2012,台大醫學院碩博士論文 劉淑媛)

如何對抗惡病質

適量醣	• 50% 全穀雜糧 水果 乳品 • 降低精緻糖攝取
高蛋白	• 維持肌肉量 保持免疫力 • 胺基酸 乳清蛋白
優脂	• 降低慢性發炎與相關併發症 • 魚油 藻油

補體素倍力

腫瘤癌症配方


衛生福利部
特殊營養食品許可證

營養介入

補體素 倍力

237ml；Fiber:3g/can

蛋白質	醣類	脂肪
23%	52%	25%

濃縮熱量 — 1.6大卡/ml，372kcal/罐
全日營養(4罐約1500kcal)

優蛋白 — 蛋白質21.6g/罐
含5.3g乳清蛋白

藻油Omega-3 — 專利藻油Omega-3 奶素可食

- 每罐含1g Omega-3 PUFAs
- Omega-6 : Omega-3 =2:1

低GI — GI值=52，含鉻

1/2 糖 — 糖量較低，僅市售一半

評估指標

臨床指標 (營養不良*)

- 體重、BMI
- 白蛋白(Alb) 等營養指標
- C-反應蛋白(CRP) 發炎指標

肌少評估指標

- 肌力(握力)
- 中臂圍** (MAC)
- CRP/Alb 比值

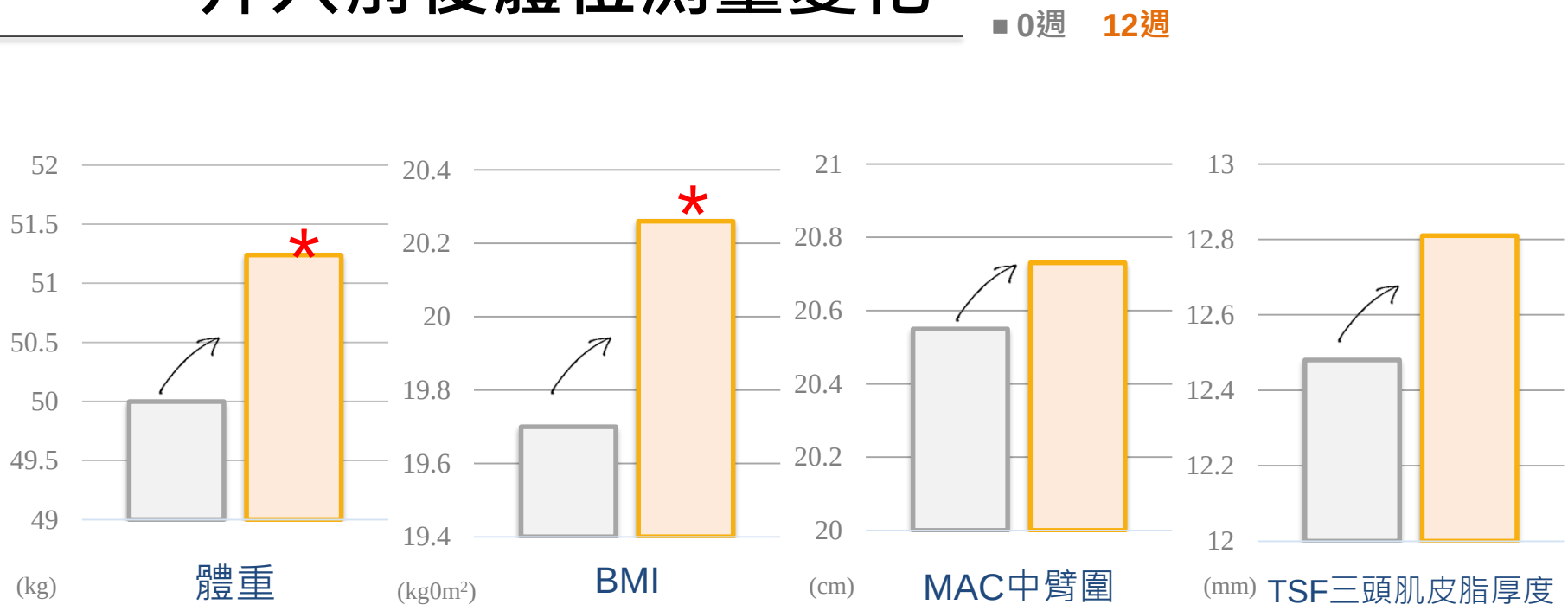
患者生理穩定指標

- 營養代謝: 血糖、血脂
- 肝、腎等器官功能 血液生化指標
- 腸道耐受性

*Moreau, J. et al. (2019). Cancer medicine, 8(8), 3677-3684.
**DA SILVA JR. et al. (2019). Nutrition, 60, 48-52.

12週 體重顯著提升

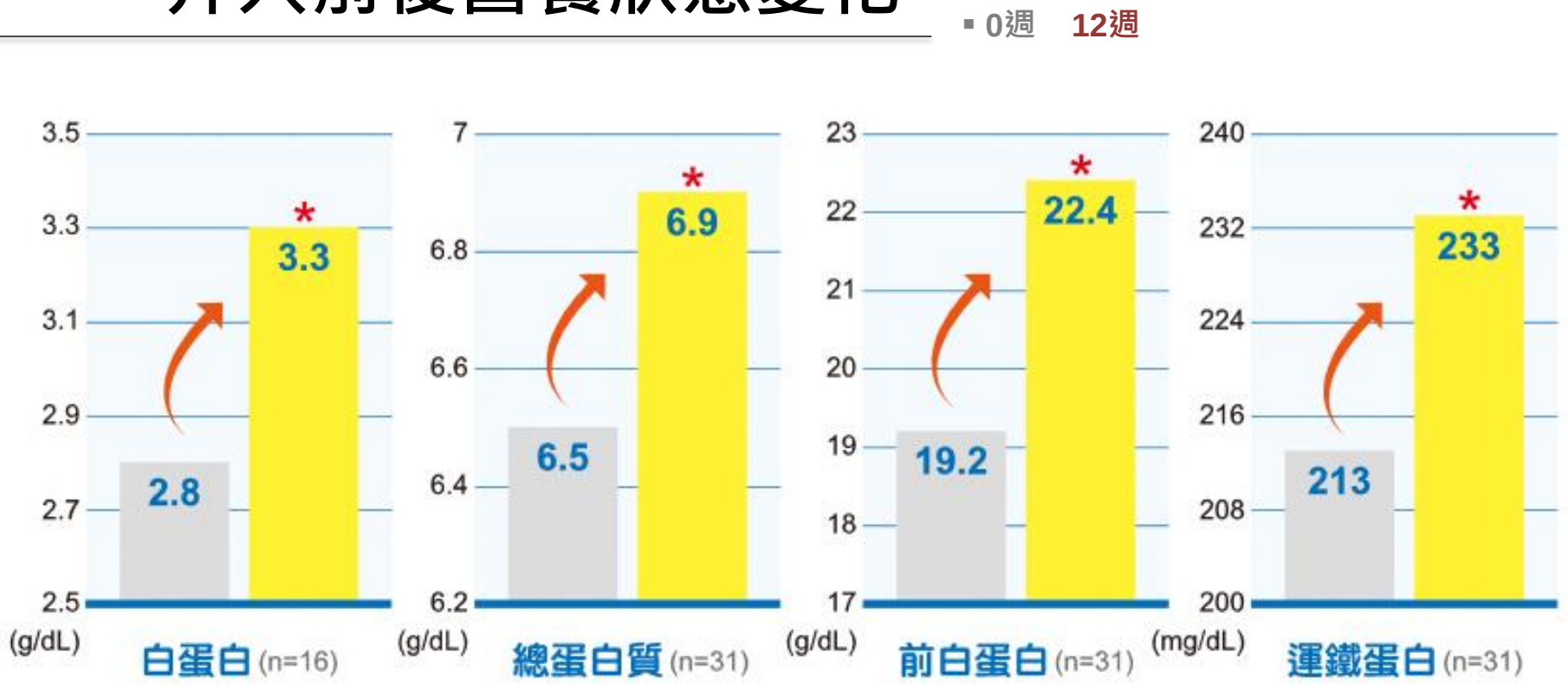
- 介入前後體位測量變化



(n=31); * $p<0.05$, between before and after supplementation.

12週 營養狀況改善

- 介入前後營養狀態變化



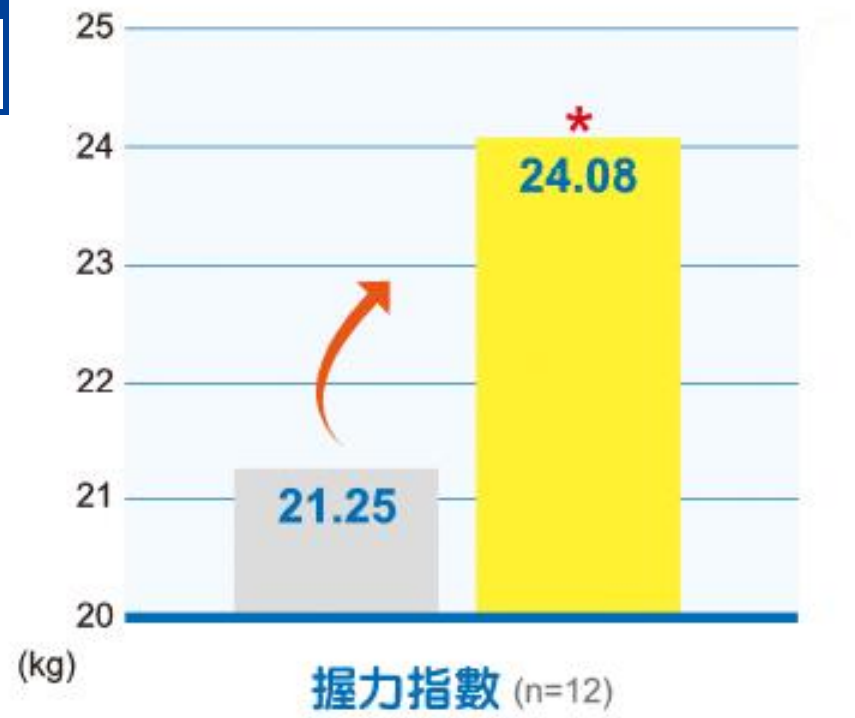
* $p<0.05$, between before and after supplementation.

12週 肌少預測指標

- 介入前後握力

握力提升

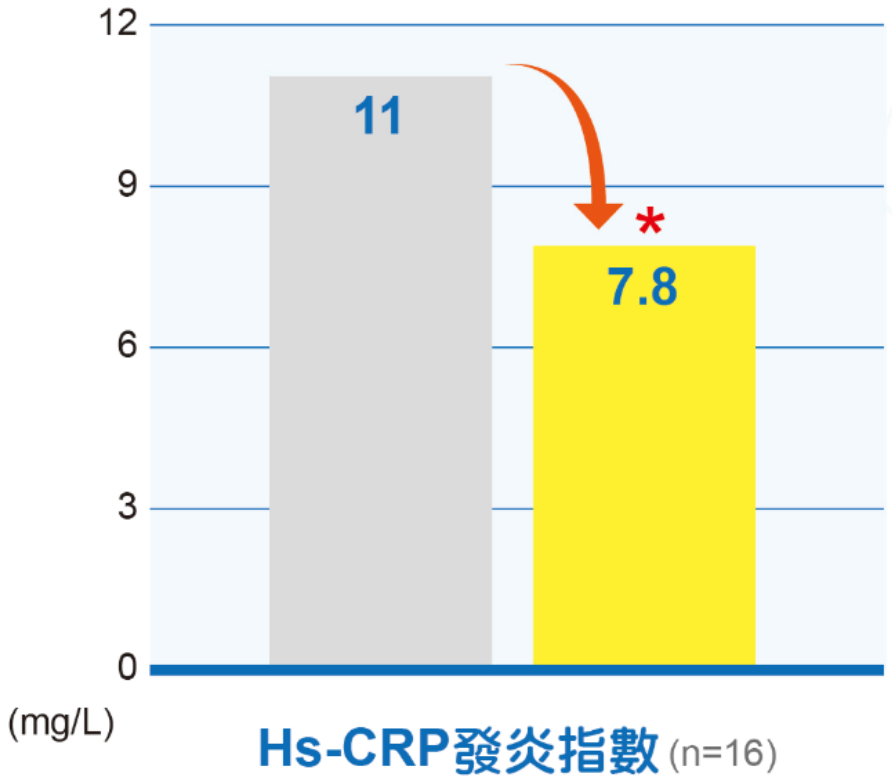
2.83kg



* (n=12); *p*-value, between before and after supplementation.

12週 控制發炎指數

- 介入前後發炎指數



初始發炎指數11.0mg/L

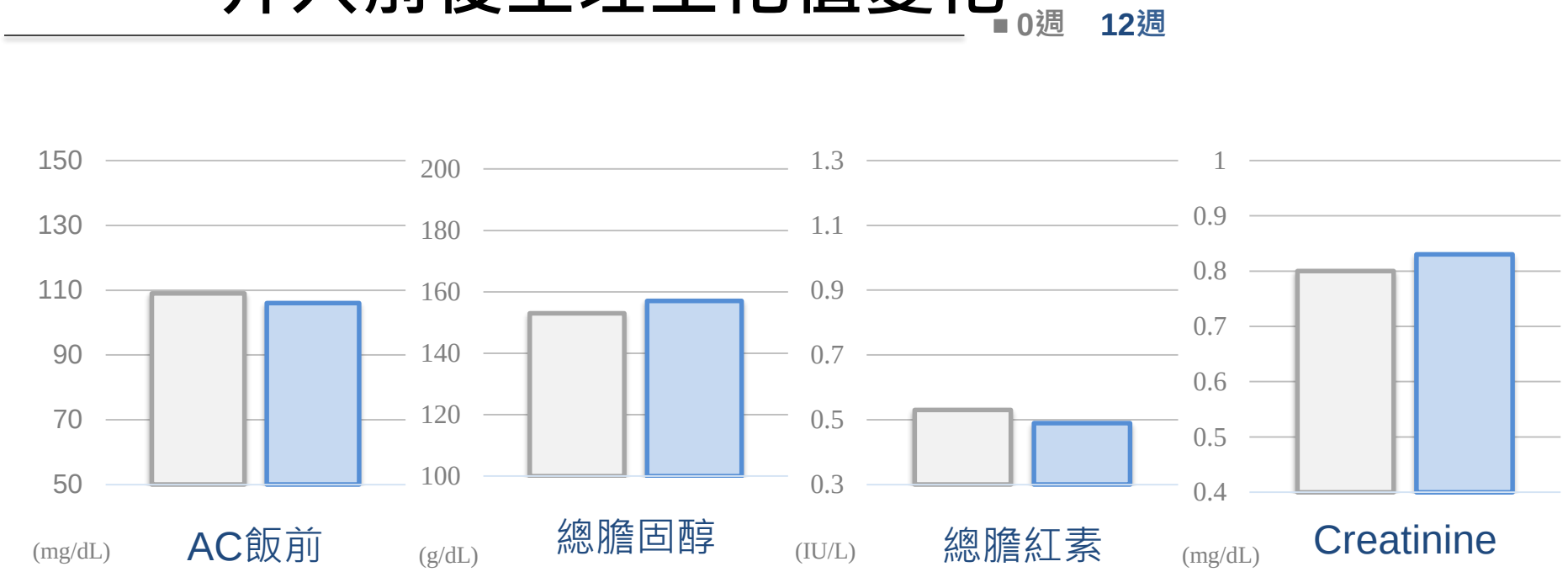
介入後發炎指數7.8mg/L

發炎指數顯著降低

* (n=16); *p*-value, between before and after supplementation.

12週 穩定血糖血脂

- 介入前後生理生化值變化



(n=31); * $p<0.05$, between before and after supplementation.

癌症患者的營養支持
謝謝聆聽