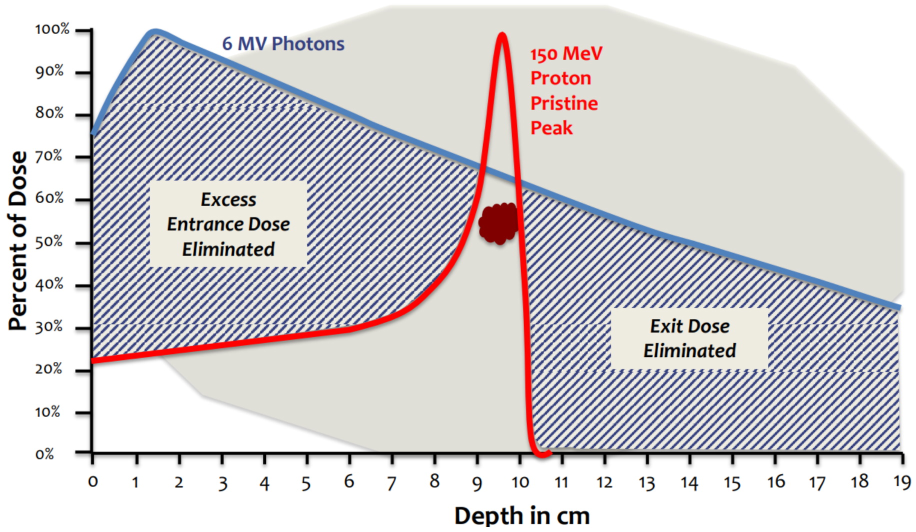
# Proton Therapy
# In
# Pediatric cancer



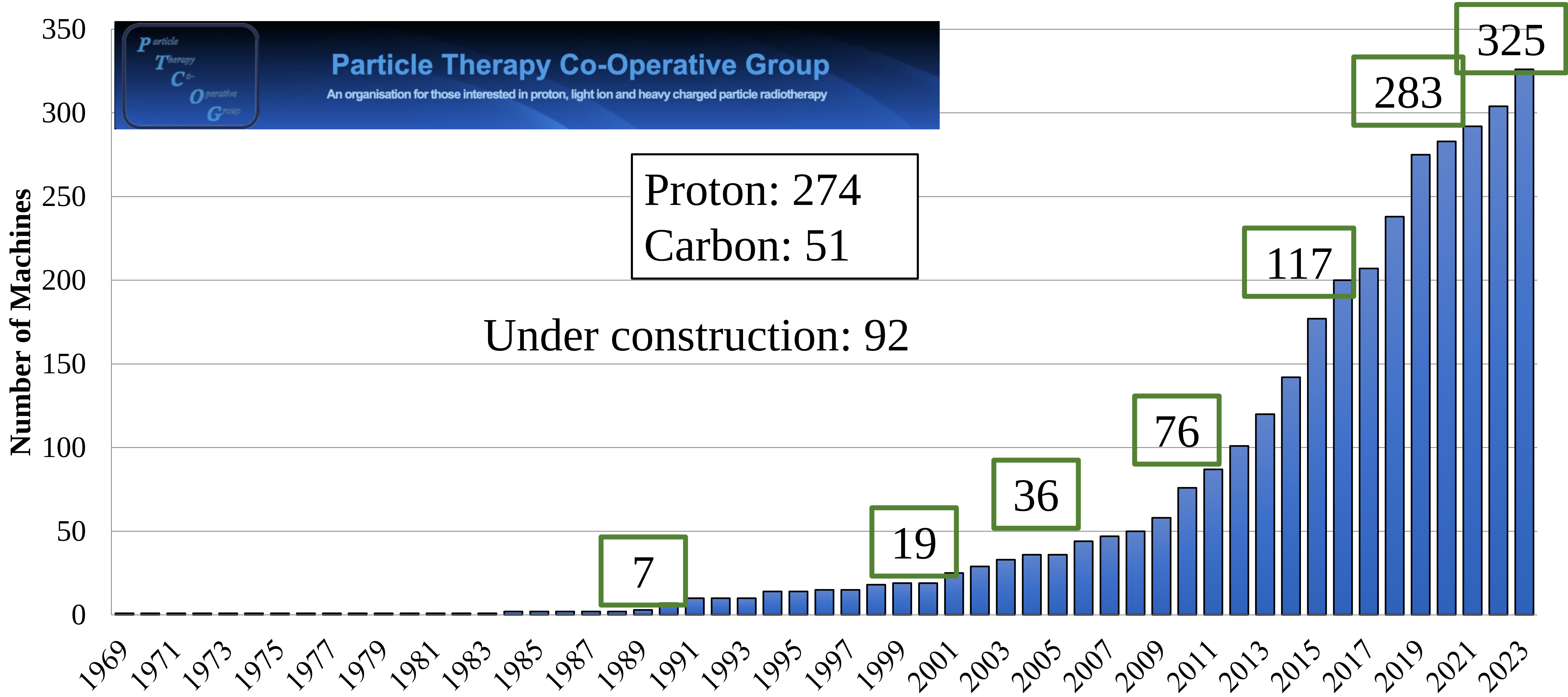


Kanjana Shotelersuk, MD

Division of Radiation Oncology

Chulalongkorn University

# No. of Particle Machines (in operation)



# ASTRO Model Policies 2017

PROTON BEAM THERAPY (PBT)

## Group I

### Frequently supported the use of PBT

- Ocular tumors
- Base of skull tumors
- Primary/metastatic tumors of the spine
- Hepatocellular carcinoma
- **Childhood tumors**
- Genetic syndromes
- Malignant/benign primary CNS tumors
- Advanced unresectable H&N cancers
- Paranasal sinus tumor
- Non-metastatic retroperitoneal sarcomas
- Re-irradiation

## Group II

### Coverage with evidence development

- Non-T4 and resectable HN cancers
- Lung cancer (M0)
- Esophageal cancer (M0)
- Mediastinal lymphomas
- Pancreatic cancer (M0)
- Biliary cancer (M0)
- Adrenal cancer (M0)
- Rectal and anal cancer (M0)
- Bladder and cervical cancers (M0)
- Prostate cancer (M0)
- Breast cancer

# ASTRO Model Policies 2023

## PROTON BEAM THERAPY (PBT)

| Group I | Group II |
|---|---|
| **Frequently support the use of PBT** | **Coverage with evidence development** |

- **Benigh or malignant** tumors or hematologic malignancies in **children aged 21 years and younger** treated with **curative intent** and **occasionally palliative intent** treatment of childhood tumors when at least one of the three criteria noted above under “indications for coverage” apply

Indications for coverage

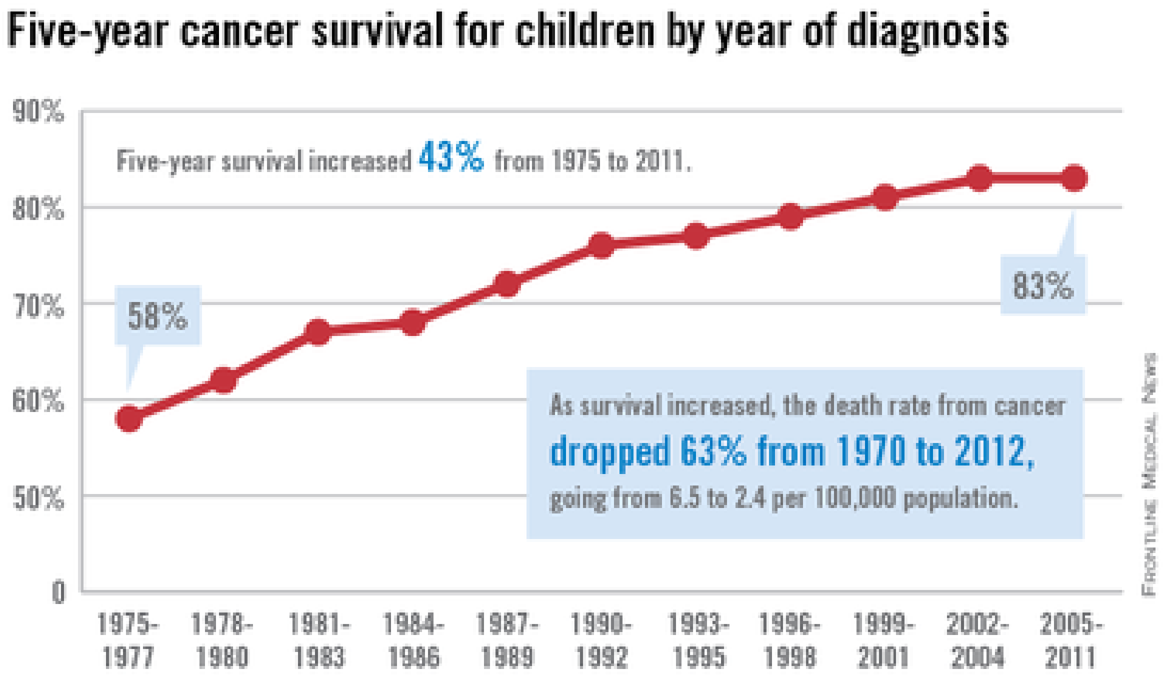
1. Target volume – near one or more critical structures and a steep dose gradient outside the target must be achieved
2. Proton technique – would decrease the probability of clinically meaningful normal tissue toxicity
3. Previously irradiated area or immediately adjacent area

*https://www.astro.org/ASTRO/media/ASTRO/Daily%20Practice/PDFs/ASTROPBTModelPolicy.pdf*

# Outline

- Why proton therapy in pediatric patient?
- Treatment outcome of proton therapy in pediatric CNS tumor
- Experience of proton therapy in pediatric patient (KCMH)
- Challenging of proton therapy in pediatric cancer

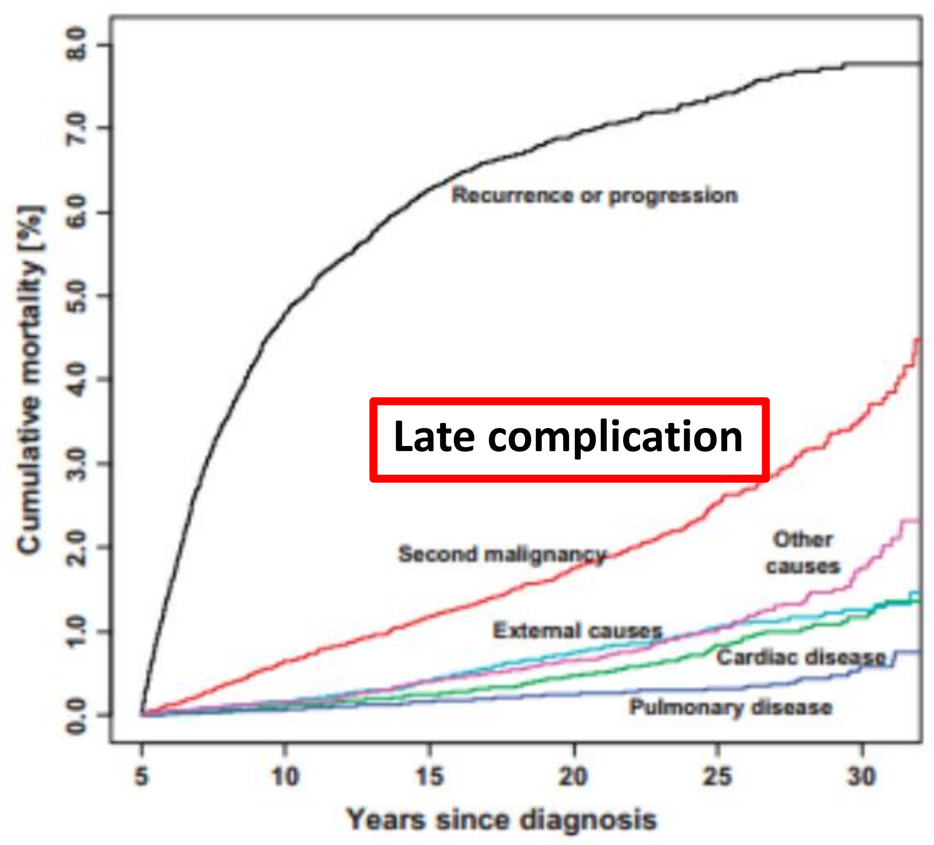
# Improvement of treatment outcome of Pediatric cancer




**Note:** Based on data for children from birth to age 14 years from the Surveillance, Epidemiology, and End Results Program.

**Source:** CA Cancer J Clin. 2016 Jan;66(1):7-30

## Childhood Cancer Survivor Study




*Mertens AC et al. J Natl Cancer Inst 2008*

# PENTEC

## Pediatric Normal Tissue Effects in the Clinic

**Table 5 Risk of symptomatic brain necrosis: Comparing PENTEC and QUANTEC summaries**

| Maximum brain dose | | |
|---|---|---|
| PENTEC | QUANTEC (adults) | Risk of symptomatic necrosis |
| * | <60 Gy | <3% |
| ~59 Gy | ~72 Gy | 5% |
| ~72 Gy | * | 8% |
| * | 90 Gy | 10% |

*Abbreviations*: PENTEC = Pediatric Normal Tissue Effects in the Clinic; QUANTEC = Quantitative Analysis of Normal Tissue Effects in the Clinic.

* Doses associated with this specific risk level were not reported.

**5% risk of developing IQ < 85 (PENTEC)**

| Irradiated brain (%) | Dose (Gy) |
|---|---|
| 10 | 35.7 |
| 20 | 29.1 |
| 50 | 22.2 |
| 100 | 18.1 |

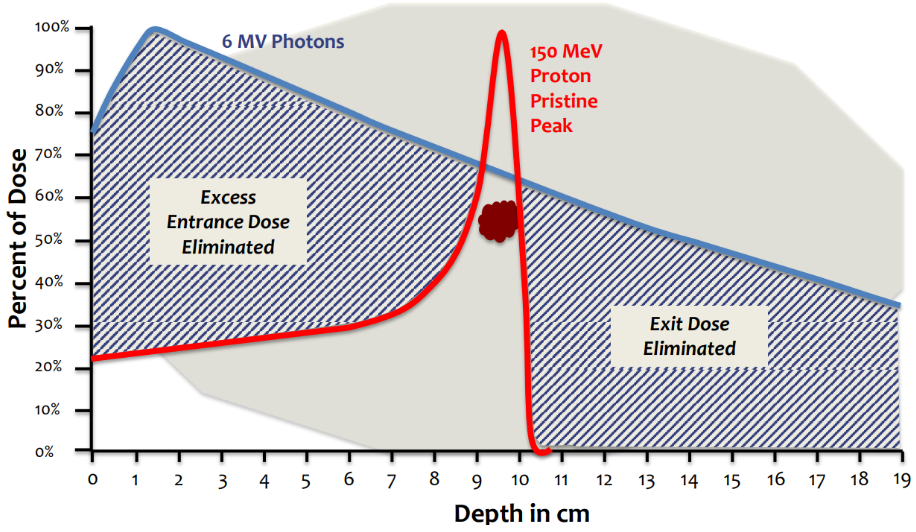
2 Gy/fx, and without use of MTX

**Pediatric – more radiosensitve**

*Mahajan A, et al. Int J Radiat Oncol Biol Phys 2020*
*Milano MT, et al. Int J Radiat Oncol Biol Phys 2023*

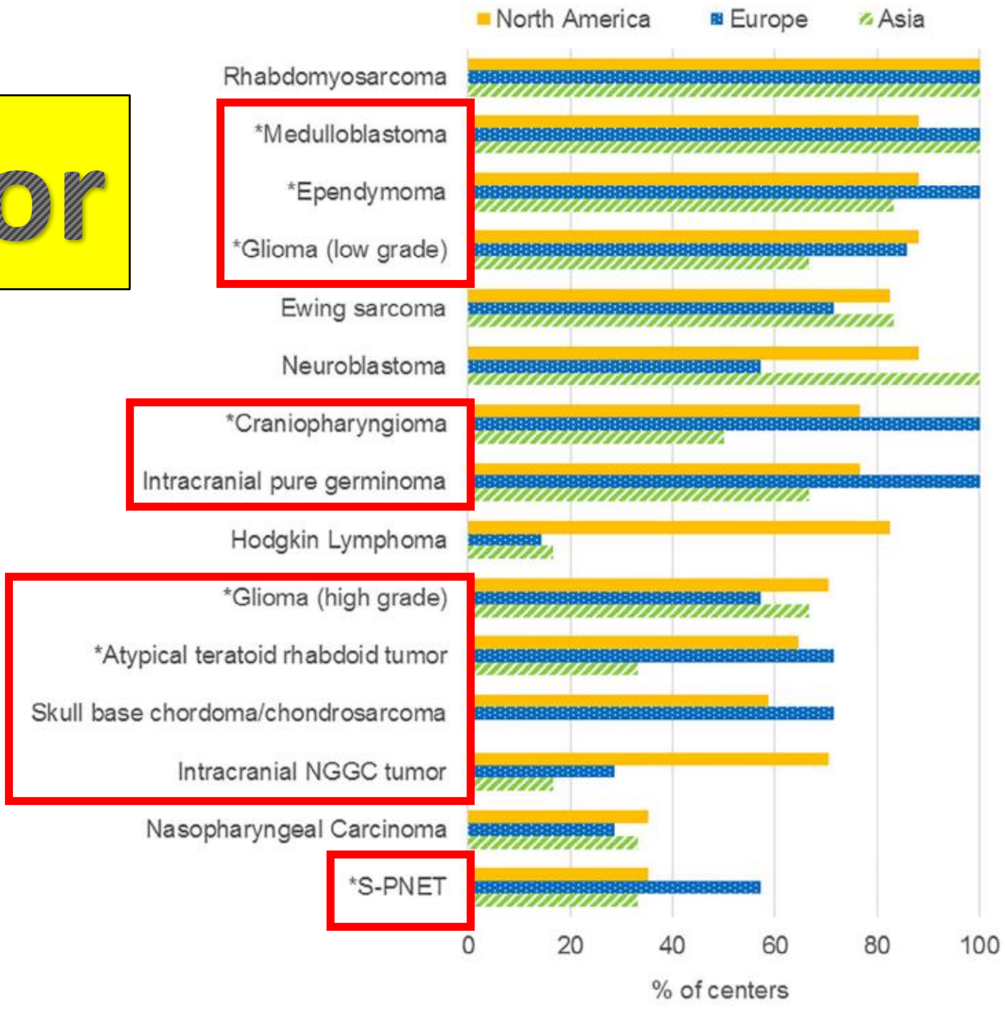
# Strategies to avoid/minimize long-term treatment side effect

- Avoidance of radiotherapy
- Delay of radiotherapy for young children
- Reduction of target volume and radiation dose
- Development of systemic chemotherapy
- Use of smaller fraction size
- Reduction of safety margin
- **Advanced RT techniques**
  - **IMRT / VMAT**
  - **Particle therapy**



# Pattern of Proton therapy in pediatric cancer

**CNS Tumor**




*Journy N, et al. Radiotherapy and Oncology 2019*

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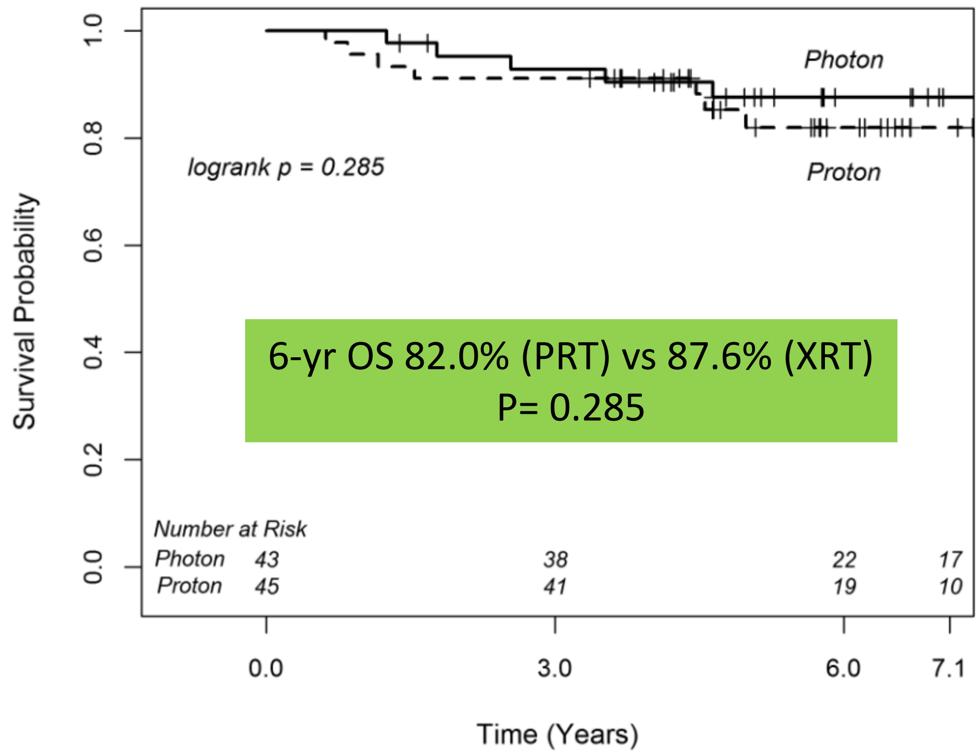
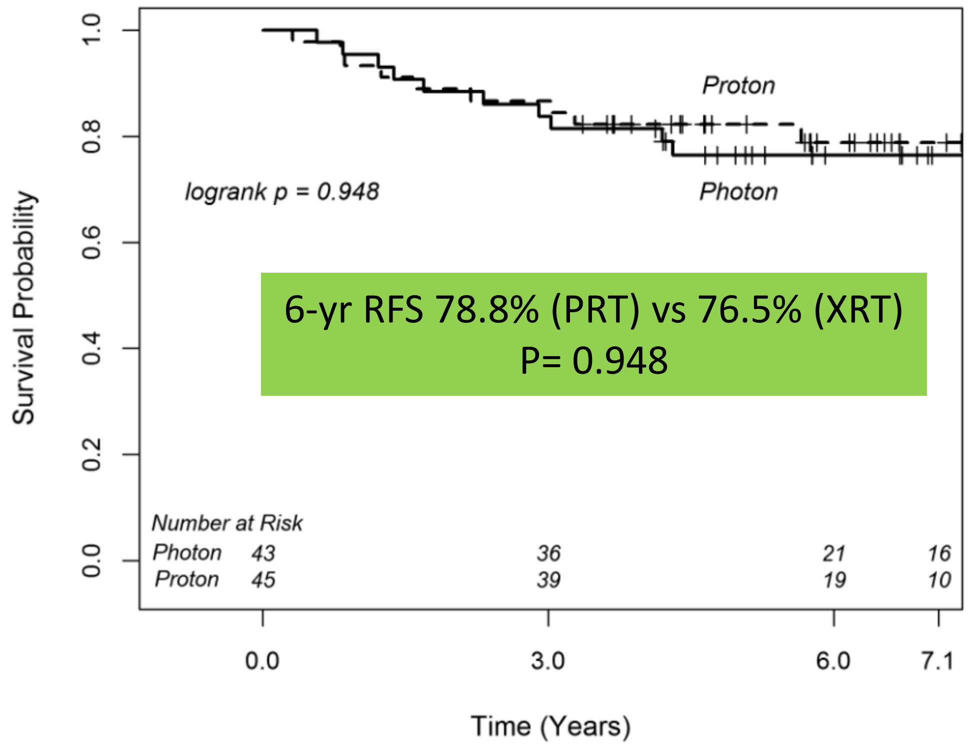
# Clinical outcome PRT vs XRT in Medulloblastoma

Proton (N=45) vs Photon (N=43)




**Overall survival**




**Relapse free survival**

RT 2000 – 2009

Median f/u – 6.2 yr (PRT), 7.0 yr (XRT)

*Eaton BR, et al. Int J Radiat Oncol Biol Phys 2016*


# Side effect of Craniospinal Irradiation

- **Acute complication**
  - Hematologic toxicities
  - Nausea/vomiting
  - Esophagitis
- **Late complication**
  - Neurocognitive
  - Endocrine abnormality
  - Ototoxicity
  - Secondary malignancy

| Toxicities (%) | P-CSI (n=60) | X-CSI (n=37) | P-value |
|---|---|---|---|
| **Leukopenia** | | | 0.044 |
| 0 | 3.3 | 0 | |
| 1 | 16.7 | 8.1 | |
| 2 | 43.3 | 37.8 | |
| 3 | 36.7 | 51.4 | |
| 4 | 0 | 2.7 | |
| Neutropenia | | | 0.762 |
| 0 | 18.6 | 17.1 | |
| 1 | 6.8 | 22.9 | |
| 2 | 49.2 | 28.6 | |
| 3 | 22 | 28.6 | |
| 4 | 3.4 | 2.9 | |
| Lymphopenia | | | <0.0001 |
| 0 | 0 | 0 | |
| 1 | 0 | 0 | |
| 2 | 23.7 | 0 | |
| 3 | 59.3 | 32.4 | |
| 4 | 16.9 | 67.6 | |

| Toxicities (%) | P-CSI | X-CSI | P-value |
|---|---|---|---|
| Anemia | | | 0.11 |
| 0 | 6.7 | 0 | |
| 1 | 58.3 | 43.2 | |
| 2 | 35 | 48.6 | |
| 3 | 0 | 8.1 | |
| 4 | 0 | 0 | |
| Thrombocytopenia | | | 0.066 |
| 0 | 71.7 | 54.1 | |
| 1 | 28.3 | 43.2 | |
| 2 | 0 | 2.7 | |
| 3 | 0 | 0 | |
| 4 | 0 | 0 | |

**Proton-CSI – Significant lower hematologic toxicity**

*Liu KX, et al. Int J Radiat Oncol Biol Phys 2021*

# QOL studies of pediatric cancer treated with PRT

| Reference | No. | Tumor status | Dose, Gy RBE | QOL/PRO parameters | End points | Conclusions | Criticisms and confounders |
|---|---|---|---|---|---|---|---|
| Kuhlthau et al., 2012 (41) | 142 | Primary brain tumors, most commonly PNET (35%), ependymoma (22%), LGG (14%); CSI in 43% PBT only (7%), PBT/surgery (31%), PBT/ chemo (9%), tri-modality (53%) | ≥45 (96%) | PedQoL: core (functioning), brain tumor (sensorimotor, neurocognitive), cancer modules (psychosocial) Also utilized Wechsler IQ scale, BASC and SIB-R (behavioral), and cross-comparison with scores provided by both parents and children Measured during the first and last weeks of PBT and annually thereafter | QOL rose from start to end of PBT in both CSI and non-CSI, but comparatively less rise from end of PBT to 3 y post-PBT During treatment, lowest scores for school and emotional functioning, anxiety/ worry, communication, physical health Worse QOL scores at start statistically correlated with baseline IQ and behavioral | QOL increases during PBT Noteworthy clinical factors associated with poorer QOL scores | Heterogeneous population with unclear dosing and likely equally heterogeneous treatment volumes Did not assess baseline home/ socioeconomic situation Analyzed PBT dose as a binary (noncontinuous) variable with imbalanced cutoff No association with receipt of anesthesia or lack thereof |
| Weber et al., 2015 (42) | 15 | Primary ATRT, resection in 93%, concurrent chemo in 47% | 54 | PedQoL: physical, emotional, social, school, psychosocial, composite Measured before PBT and compared with measurement at 2 mo | Numerically higher physical, emotional, school scores Numerically lower social score | QOL does not deteriorate at median 33 mo after PBT | Mean (no median) values of QOL scores reported, without statistical comparisons Did not assess baseline home/ socioeconomic situation Isolated comparison at just 2 mo post-PBT difficult to interpret regarding long-term QOL |
| Leiser et al., 2016 (43) | 93 | Rhabdomyosarcoma, concurrent chemo in 89%, anesthesia in 66% | 54 | PedQoL measured at baseline and 2 mo post-PBT, and annually thereafter; matched with proxy normal population Questionnaire given to 34 patients | Lower QOL at beginning of PBT vs normal population QOL improves (all domains) at 2 mo post-PBT and continues to 2 y; most notable improvement in first year post-PBT At 2 y, most QOL parameters comparable (or higher) with normal population | QOL increases after PBT | Details regarding surgery missing Excluded patients age < 5 y from QOL analyses Did not assess baseline home/ socioeconomic situation Unclear matching of comparison with proxy normal population |

QOL increases during and after PBT

*Verma V, et al. J Natl Cancer Inst 2018*

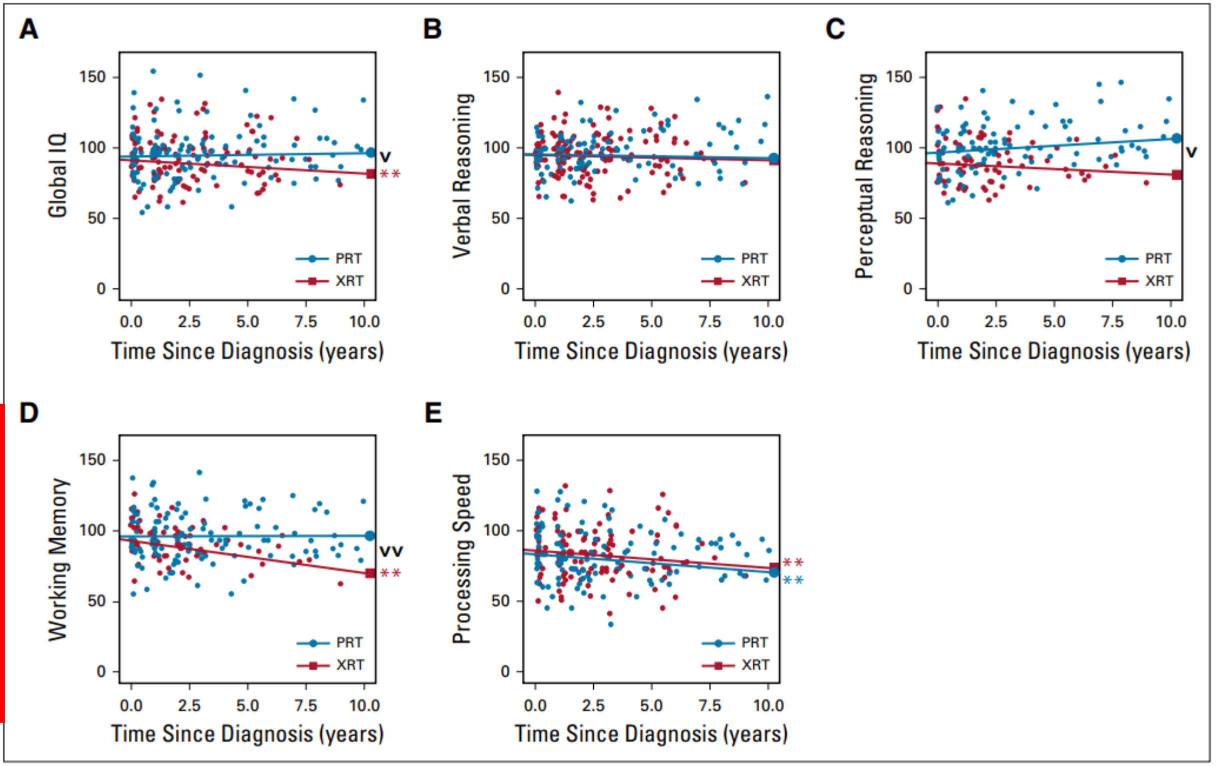
# Endocrine outcome PRT vs XRT in MB

| | PRT (N=40) | XRT (N=37) | P value |
|---|---|---|---|
| Median age | 6.2 yr | 8.3 yr | 0.01 |
| Median f/u | 5.8 yr | 7.0 yr | 0.01 |
| **Hypothyroidism** | **23%** | **69%** | **< 0.001** |
| **Sex hormone deficiency** | **3%** | **19%** | **0.025** |
| **Endocrine Replacement Rx** | **55%** | **78%** | **0.03** |
| GH deficiency | 53% | 57% | 0.708 |
| Adrenal insufficiency | 5% | 8% | 0.667 |
| Precocious puberty | 18% | 16% | 0.881 |

*Eaton BR, et al. Neuro Oncol 2016*

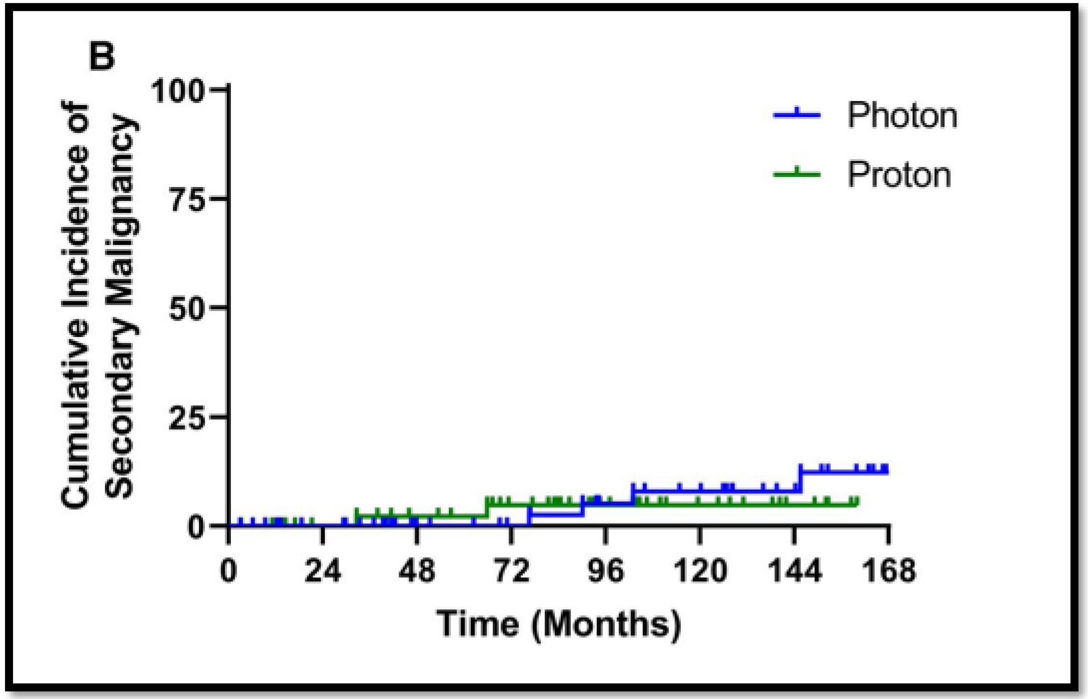
# Superior Intellectual Outcomes after PRT vs XRT in MB

- 79 patients, between 2007 - 2018
  - 37 PRT (MDACC)
  - 42 XRT (Sick Kids, Canada)
- Tumor bed boost margin
  - XRT – 1 cm margin
  - PRT – 1 cm margin (62%) and 0.5 cm margin (38%)
- **Proton RT – superior long-term outcomes in**
  - **Global IQ**
  - **Perceptual reasoning**
  - **Working memory**
- Comparable rate of relapse




*Kahalley LS, et al. J Clin Oncol 2019*

# Risk of secondary malignant neoplasm In pediatric medulloblastoma




| SMN | X-ray (N= 63) 1996-2005 | Proton (N=52) 2006-2014 |
|---|---|---|
| f/u time (yr) | 12.8 | 8.7 |
| At 10 yr | 8% (4 pt) | 4.9% (2 pt) |

Passive scatter

*Paulino A, et al. Cancer 2021*

# Outline

- Why proton therapy in pediatric patient?
- Treatment outcome of proton therapy in pediatric CNS tumor
- Experience of proton therapy in pediatric patient (KCMH)
- Challenging of proton therapy in pediatric cancer


August 1, 2021

# Number of pediatric cancer cases treated with radiotherapy at KCMH

| | 2021 | 2022 | 2023 |
|---|---|---|---|
| **Treated with RT/year** | 66 | 65 | 76 |
| - XRT | 62 | 57 | 61 |
| - PRT | 4 | 8 | 15 |
| **Type of tumor treated With proton** | | | |
| - Medulloblastoma | 1 | 2 | 4 |
| - Germ cell tumors | 1 | 1 | 3 |
| - Neuroblastoma | 1 | 1 | 2 |
| - Ependymoma | 1 | 1 | 1 |
| - Rhabdomyosarcoma | | 2 | 1 |
| - Meningioma | | 1 | 1 |
| - ATRT | | | 2 |
| - Esthesioneuroblastoma | | | 1 |

**CSI 13 cases**

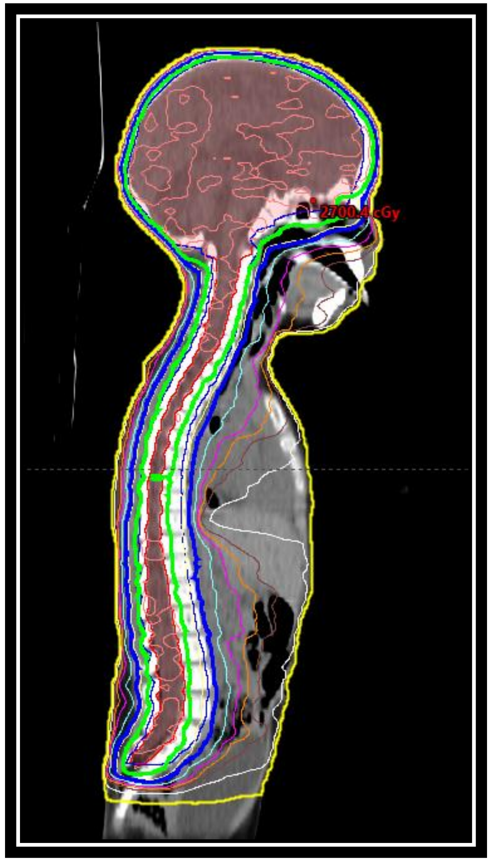
# Dosimetric comparison: Craniospinal Irradiation

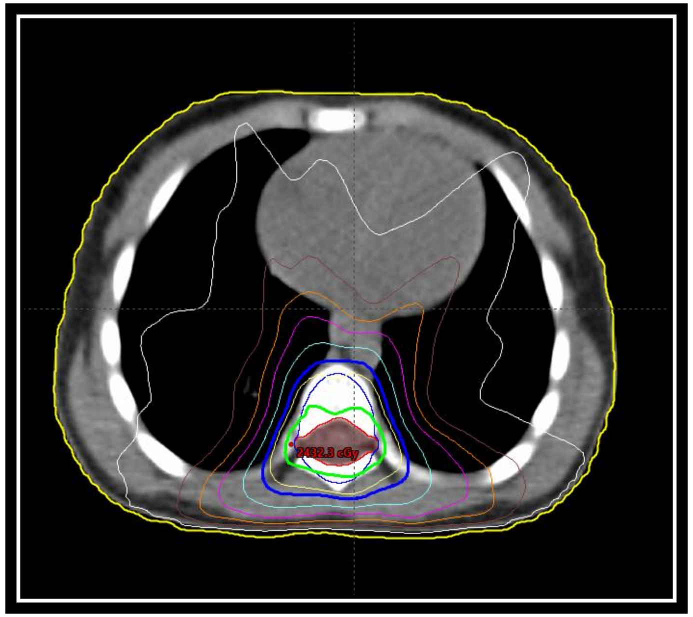

**3D**

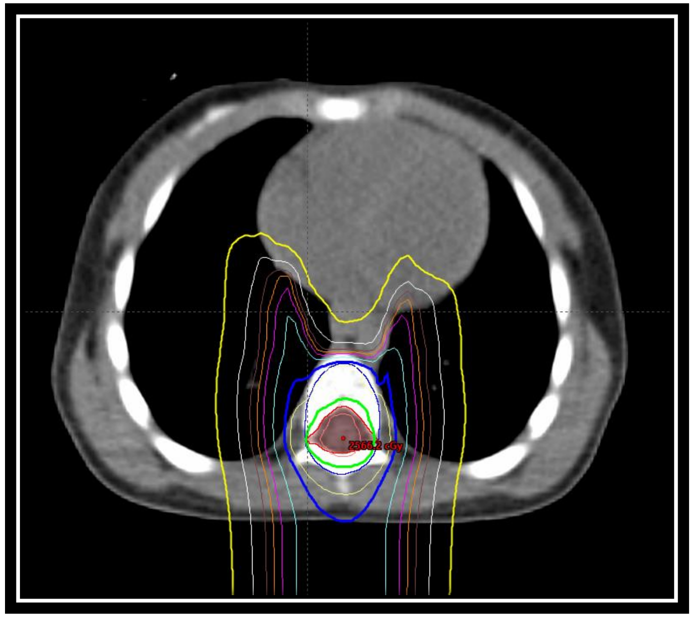

**VMAT**

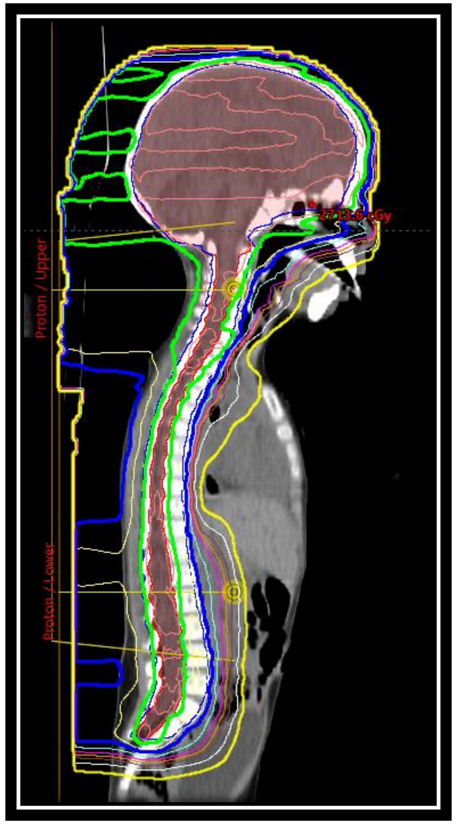

**Proton**

# Dosimetric comparison: Craniospinal Irradiation







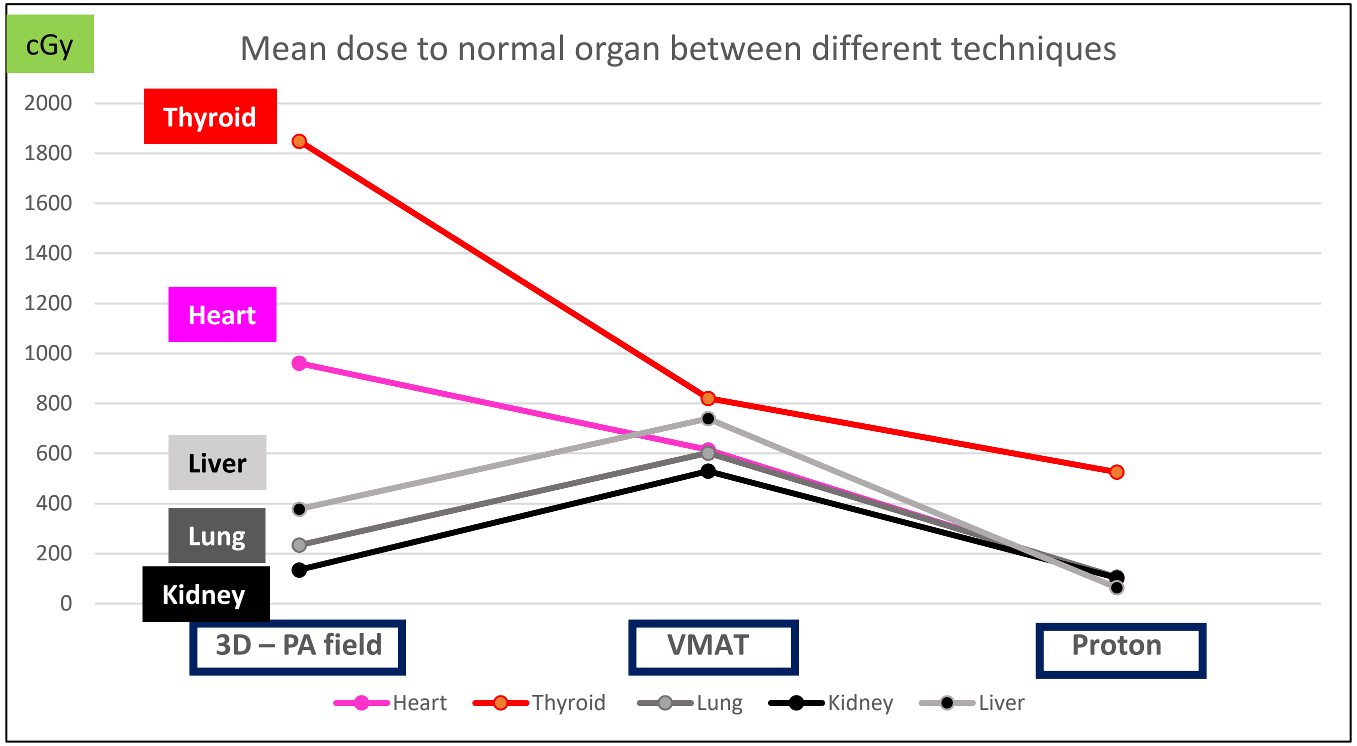


**VMAT 23.4/18.4**

**Proton 23.4/18.4**

Isodose Levels [cGy]
- 2700.0
- 2500.0
- 2340.0
- 2000.0
- 1840.0
- 1500.0
- 1200.0
- 1000.0
- 800.0
- 500.0
- 200.0

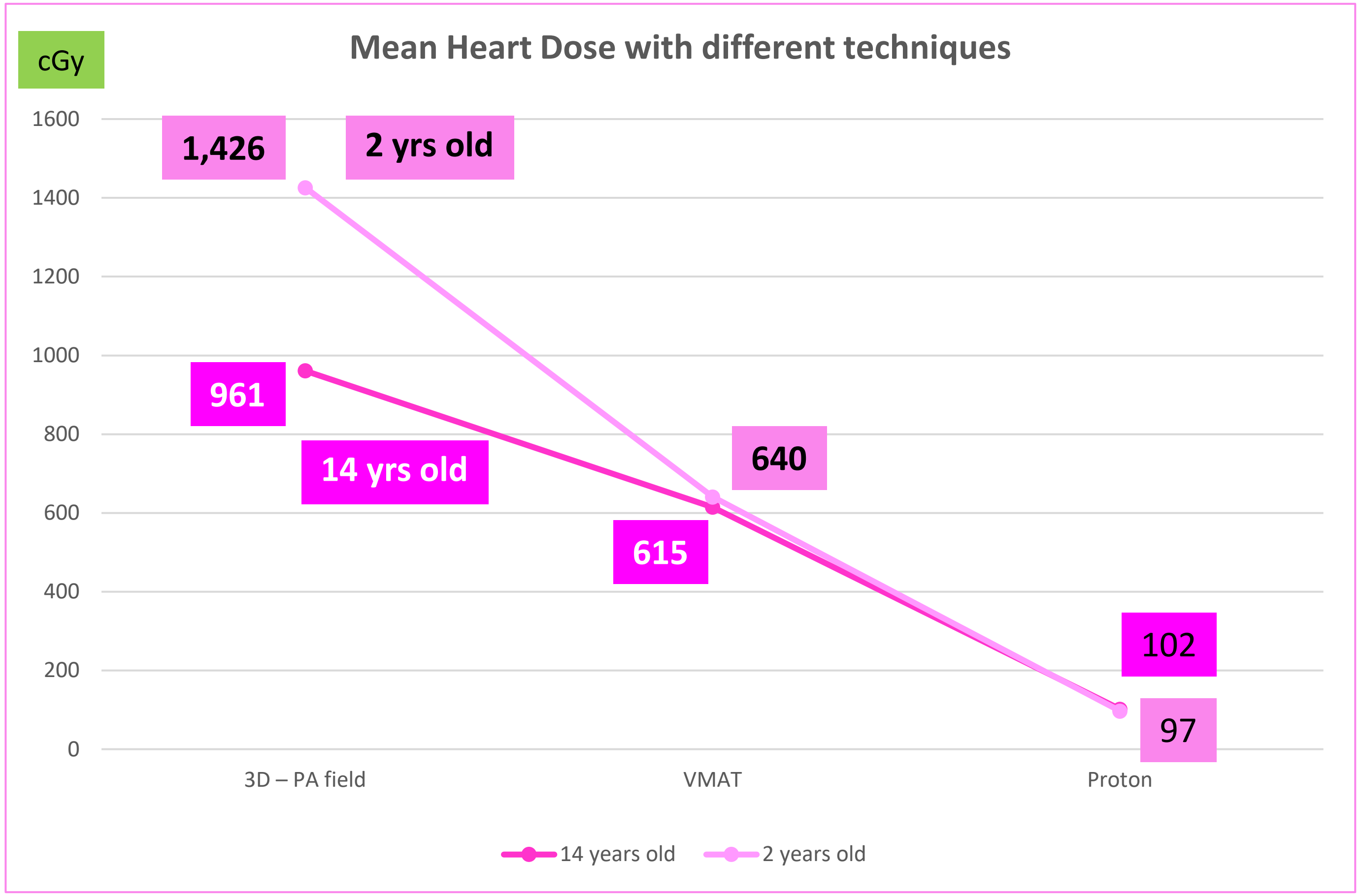
# Less radiation exposure with proton




**14-year-old male, CSI dose : 2,340 cGy**

| Organ | 3D – PA field (cGy) | VMAT (cGy) | Proton (cGy) |
|---|---|---|---|
| Thyroid | 1,849 | 821 | 526 |
| Heart | 961 | 615 | 102 |
| Liver | 378 | 740 | 64 |
| Lung | 234 | 602 | 106 |
| Kidney | 135 | 530 | 103 |

# More benefit in younger patient



SIOP 2023
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55TH CONGRESS OF THE INTERNATIONAL SOCIETY OF PAEDIATRIC ONCOLOGY
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# RELATIVE RISK OF CARDIAC MORTALITY AND DOSIMETRIC COMPARISON AMONG THREE-DIMENSIONAL RADIOTHERAPY, VOLUME MODULATED ARC THERAPY AND PROTON BEAM IN VERTEBRAL BODY-REDUCED-DOSE CRANIOSPINAL IRRADIATION

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Division of Radiation Oncology, Department of Radiology, Faculty of Medicine, Chulalongkorn University,
King Chulalongkorn Memorial Hospital, Thai Red Cross Society, Bangkok, Thailand

## Background and Aims

We aimed to compare dose to organs at risk (OARs), and the relative risk (RR) of cardiac mortality among three-dimensional conformal radiotherapy (3D-CRT), volume modulated arc therapy (VMAT) and pencil beam scanning proton therapy (PT) in craniospinal irradiation (CSI).

## Methods

CSI plans of 3D-CRT, VMAT and PT were generated. To reduce dose to OARs and avoid spinal abnormality, vertebral body-reduced-dose (VBRD) CSI according to SIOP recommendation was used for VMAT and PT. We delineated 2 sets of target volumes, i.e., clinical target volume1 and planning target volume1 (CTV1, PTV1) for brain and thecal sac and CTV2, PTV2 for vertebral body. Two sets of CSI dose, i.e., 23.4 and 36 Gy were prescribed to each technique. For VMAT and PT, 23.4/18.4 Gy and 36/20 Gy for PTV1/PTV2 (CTV1/CTV2 for PT) were optimized in 13 and 20 fractions, respectively. For 3D-CRT, we prescribed 23.4 and 36 Gy, to cover only PTV1. To evaluate the relative risk (RR) of cardiac mortality compared with normal population, we incorporated the mean heart dose (MHD) with the linear model.

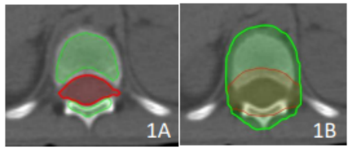
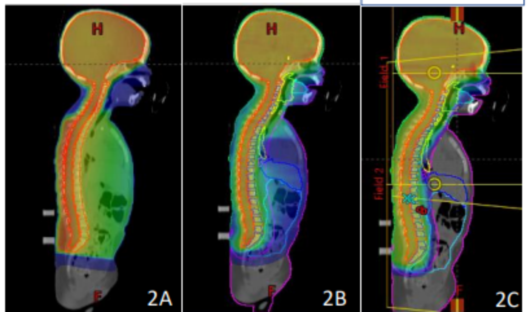



Figure 1A: CTV1 (red) and CTV2 (green)
Figure 1B: PTV 1 (red) and PTV 2 (green)

Figure 2: Dose color wash of 3D-CRT (2A), VMAT (2B), PT (2C)




## Results

In total of 8 patients, 48 treatment plans, i.e., 8 plans for each technique of each dose set, were generated. PT showed the lowest mean dose to all OARs, i.e., heart, lungs, liver, kidneys, esophagus, oral cavity, stomach, thyroids, and vertebral body. MHD of 3D-CRT, VMAT and PT were 12.15, 3.99 and 0.9 Gy for 23.4 Gy-prescription, and 18.6, 5.7, and 1.2 Gy for 36 Gy-prescription, respectively. PT showed significantly less RR of cardiac mortality compared with 3D-CRT and VMAT, 1.54, 8.92 and 3.40 for 23.4 Gy-prescription (p<0.001) and 1.74, 12.19, 4.40 for 36 Gy-prescription (p<0.001), respectively.

## Tables

Table 1: Dose to organs at risk (23.4 Gy-prescription)

| Mean dose | 3D-CRT (Gy) | VMAT (Gy) | PT (Gy) | p-value |
|---|---|---|---|---|
| Heart | 12.15 | 3.99 | 0.9 | <0.001 |
| Lung | 3.64 | 6.59 | 1.95 | <0.001 |
| Esophagus | 21.59 | 14.57 | 11.66 | <0.001 |
| Oral cavity | 3.39 | 7.65 | 2.16 | 0.002 |
| Thyroid | 17.19 | 14.06 | 7.82 | <0.001 |
| Stomach | 4.26 | 6.17 | 0.28 | <0.001 |
| Vertebral body | 24.44 | 22.59 | 21.11 | <0.001 |
| Kidneys | 2.83 | 5.8 | 2.18 | <0.001 |
| Liver | 5.23 | 5.96 | 0.44 | <0.001 |

Table 2 Dose to organs at risk (36 Gy-prescription)

| Mean dose | 3D-CRT (Gy) | VMAT (Gy) | PT (Gy) | p-value |
|---|---|---|---|---|
| Heart | 18.6 | 5.7 | 1.2 | <0.001 |
| Lung | 5.6 | 9.06 | 2.6 | <0.001 |
| Esophagus | 33.12 | 17.22 | 14.28 | <0.001 |
| Oral cavity | 4.76 | 10.63 | 2.64 | 0.002 |
| Thyroid | 25.28 | 18.08 | 10.41 | <0.001 |
| Stomach | 6.54 | 8.13 | 0.29 | <0.001 |
| Vertebral body | 37.44 | 31.76 | 28.1 | <0.001 |
| Kidneys | 4.33 | 7.17 | 2.47 | <0.001 |
| Liver | 7.07 | 8.19 | 0.52 | <0.001 |

## Conclusions

With VBRD-CSI, PT reduced mean dose to all OARs and significantly reduced RR of cardiac mortality compared with 3D-CRT and VMAT. The advantages of PT were manifested especially with high-dose CSI.

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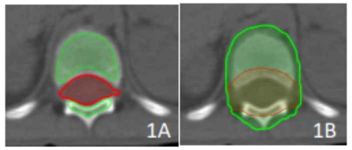


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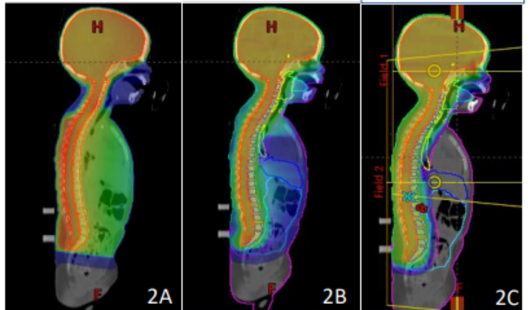



## Results

In total of 8 patients, 48 treatment plans, i.e., 8 plans for each technique of each dose set, were generated. PT showed the lowest mean dose to all OARs, i.e., heart, lungs, liver, kidneys, esophagus, oral cavity, stomach, thyroids, and vertebral body. MHD of 3D-CRT, VMAT and PT were 12.15, 3.99 and 0.9 Gy for 23.4 Gy-prescription, and 18.6, 5.7, and 1.2 Gy for 36 Gy-prescription, respectively. PT showed significantly less RR of cardiac mortality compared with 3D-CRT and VMAT, 1.54, 8.92 and 3.40 for 23.4 Gy-prescription ($p<0.001$) and 1.74, 12.19, 4.40 for 36 Gy-prescription ($p<0.001$), respectively.

## Tables

Table 1: Dose to organs at risk (23.4 Gy-prescription)

| Mean dose | 3D-CRT (Gy) | VMAT (Gy) | PT (Gy) | p-value |
|---|---|---|---|---|
| Heart | 12.15 | 3.99 | 0.9 | <0.001 |
| Lung | 3.64 | 6.59 | 1.95 | <0.001 |
| Esophagus | 21.59 | 14.57 | 11.66 | <0.001 |
| Oral cavity | 3.39 | 7.65 | 2.16 | 0.002 |
| Thyroid | 17.19 | 14.06 | 7.82 | <0.001 |
| Stomach | 4.26 | 6.17 | 0.28 | <0.001 |
| Vertebral body | 24.44 | 22.59 | 21.11 | <0.001 |
| Kidneys | 2.83 | 5.8 | 2.18 | <0.001 |
| Liver | 5.23 | 5.96 | 0.44 | <0.001 |

Table 2 Dose to organs at risk (36 Gy-prescription)

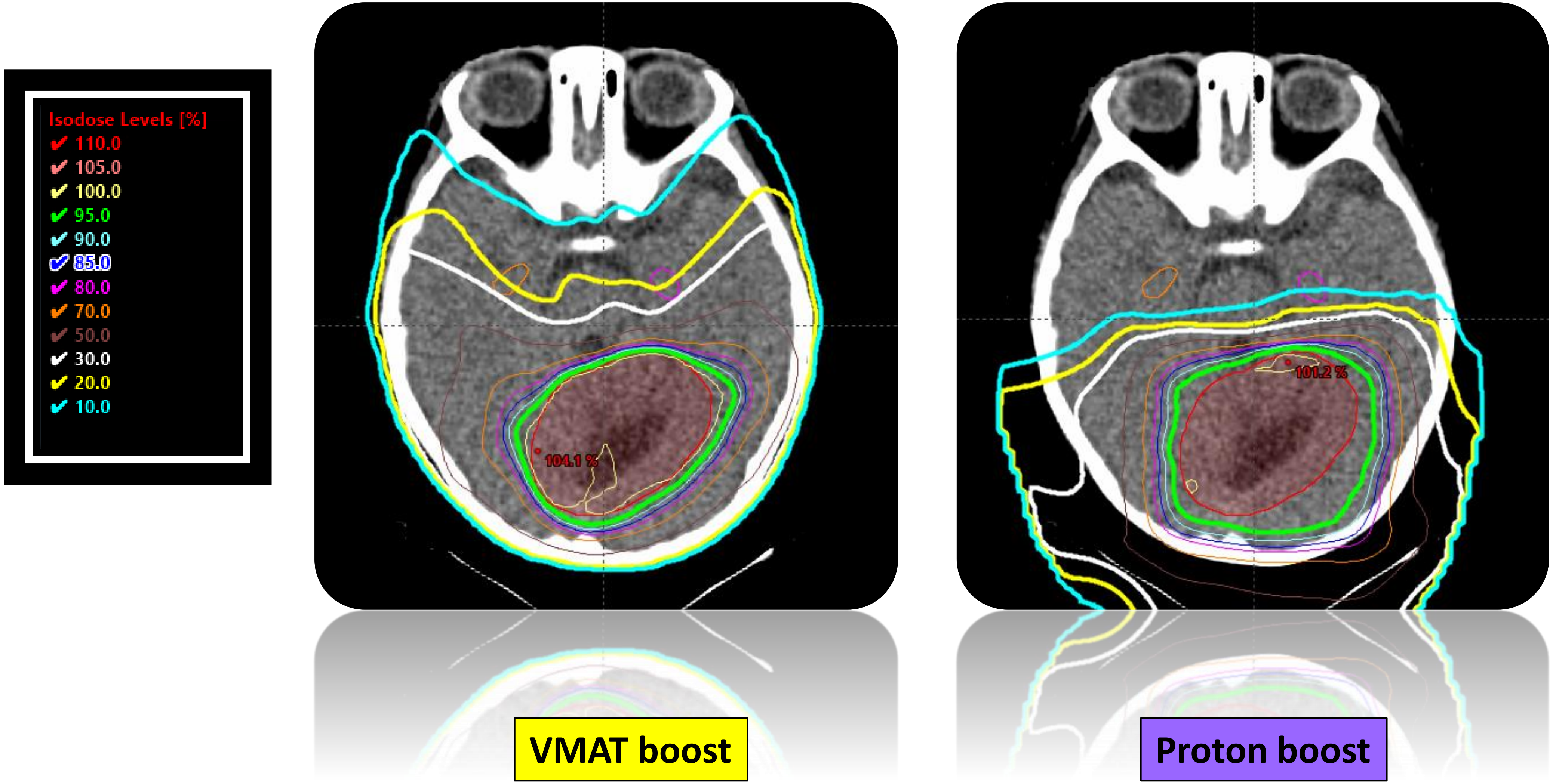
| Mean dose | 3D-CRT (Gy) | VMAT (Gy) | PT (Gy) | p-value |
|---|---|---|---|---|
| Heart | 18.6 | 5.7 | 1.2 | <0.001 |
| Lung | 5.6 | 9.06 | 2.6 | <0.001 |
| Esophagus | 33.12 | 17.22 | 14.28 | <0.001 |
| Oral cavity | 4.76 | 10.63 | 2.64 | 0.002 |
| Thyroid | 25.28 | 18.08 | 10.41 | <0.001 |
| Stomach | 6.54 | 8.13 | 0.29 | <0.001 |
| Vertebral body | 37.44 | 31.76 | 28.1 | <0.001 |
| Kidneys | 4.33 | 7.17 | 2.47 | <0.001 |
| Liver | 7.07 | 8.19 | 0.52 | <0.001 |

## Conclusions

With VBRD-CSI, PT reduced mean dose to all OARs and significantly reduced RR of cardiac mortality compared with 3D-CRT and VMAT. The advantages of PT were manifested especially with high-dose CSI.

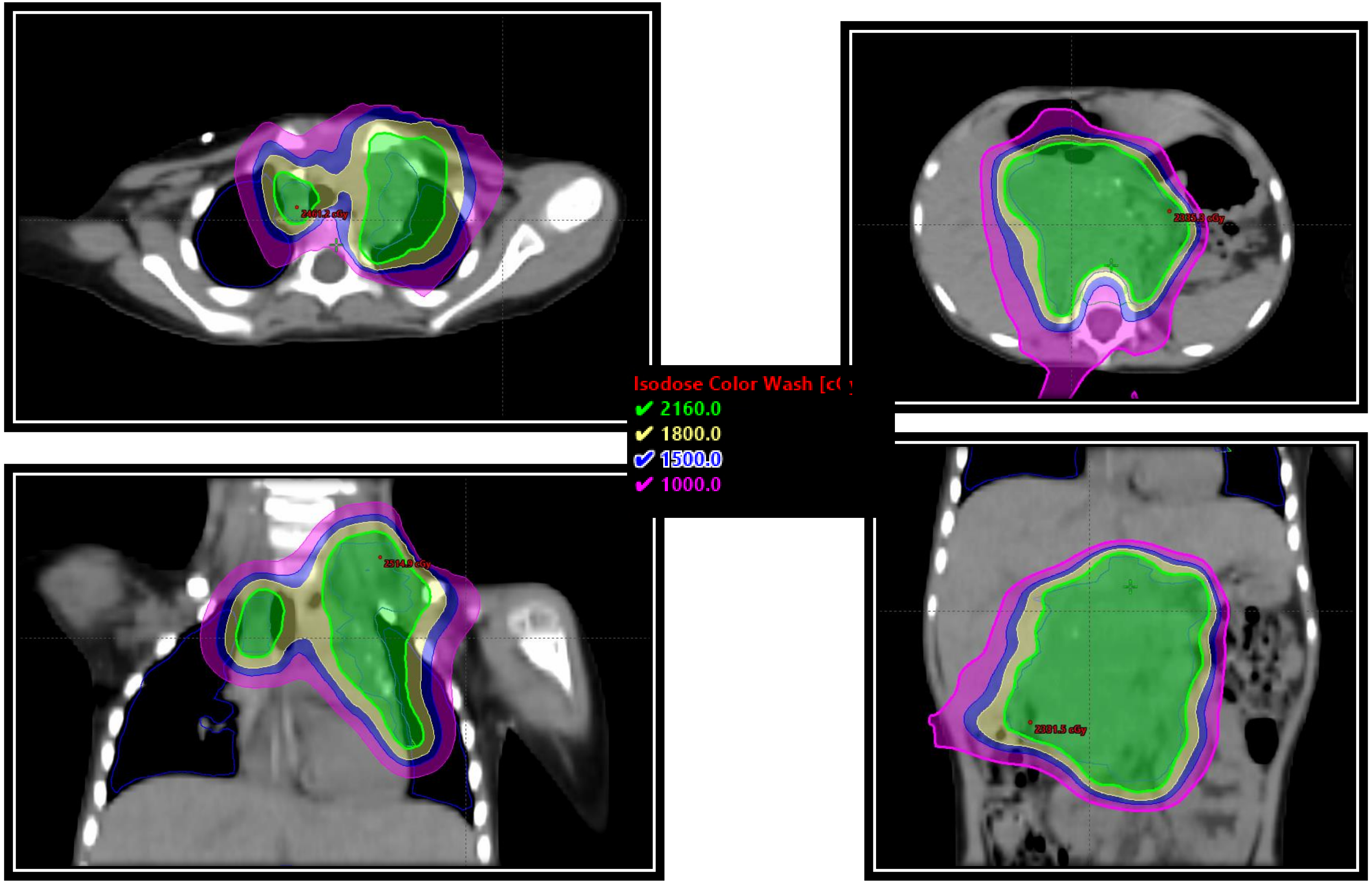
# RR of cardiac mortality

| | 3D-CRT | VMAT | Proton |
|---|---|---|---|
| CSI 23.4 Gy | 8.92 | 3.4 | 1.52 |
| CSI 36 Gy | 12.19 | 4.4 | 1.74 |

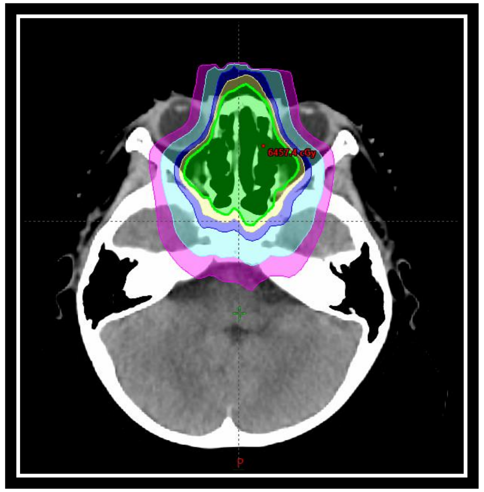


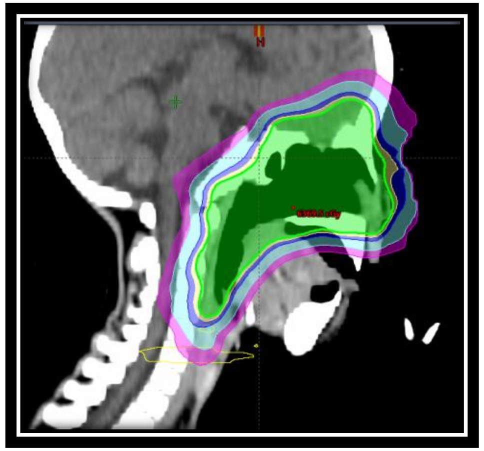
Isodose Levels [%]
110.0
105.0
100.0
95.0
90.0
85.0
80.0
70.0
50.0
30.0
20.0
10.0
104.1 %
VMAT boost
101.2 %
Proton boost

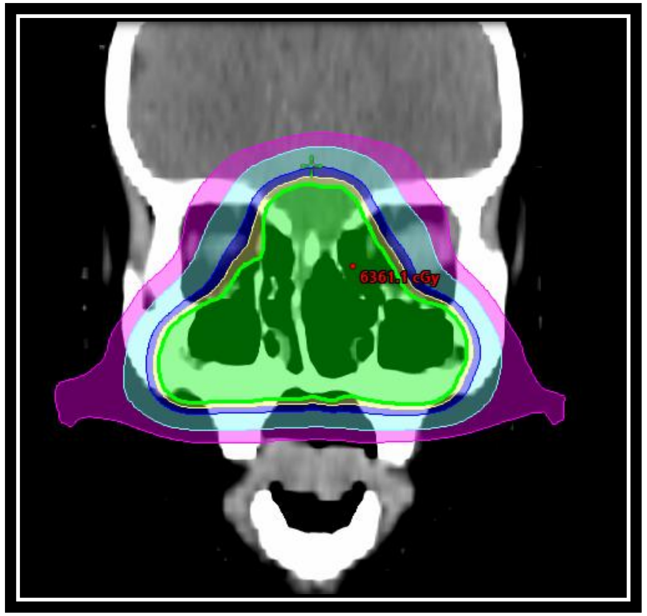
# Neuroblastoma



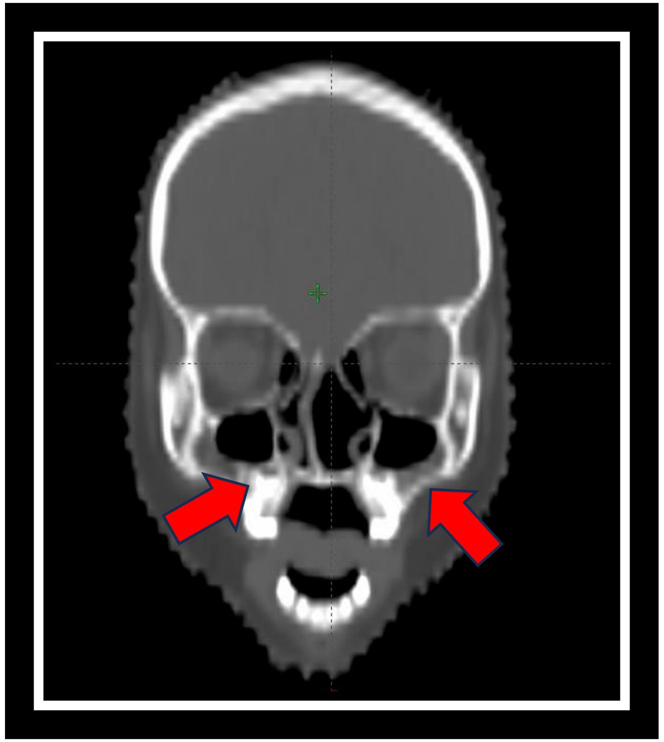
# Esthesioneuroblastoma



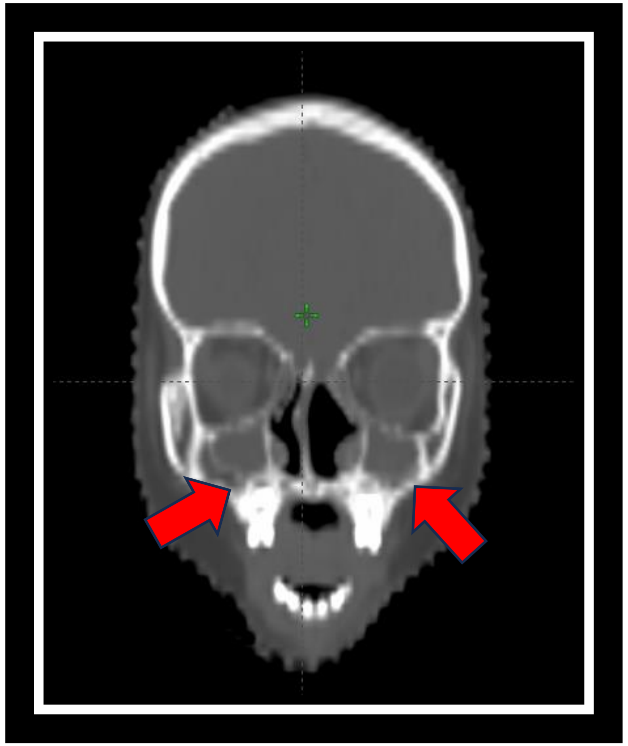





Isodose Color Wash [cGy]
- ✔ 5400.0
- ✔ 5040.0
- ✔ 4500.0
- 3068.2
- ✔ 3000.0
- ✔ 2000.0

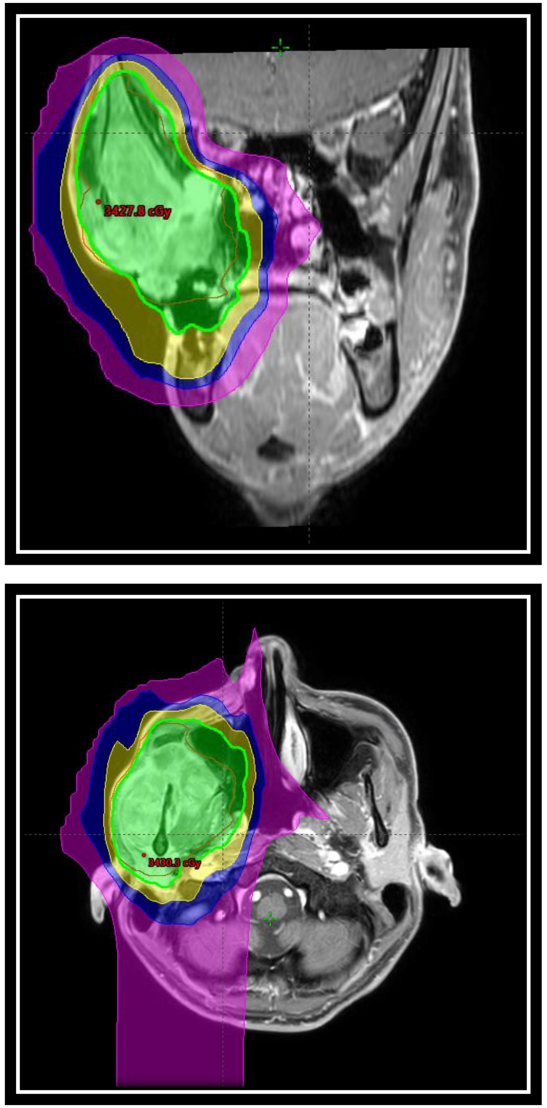


Initial CT simulation

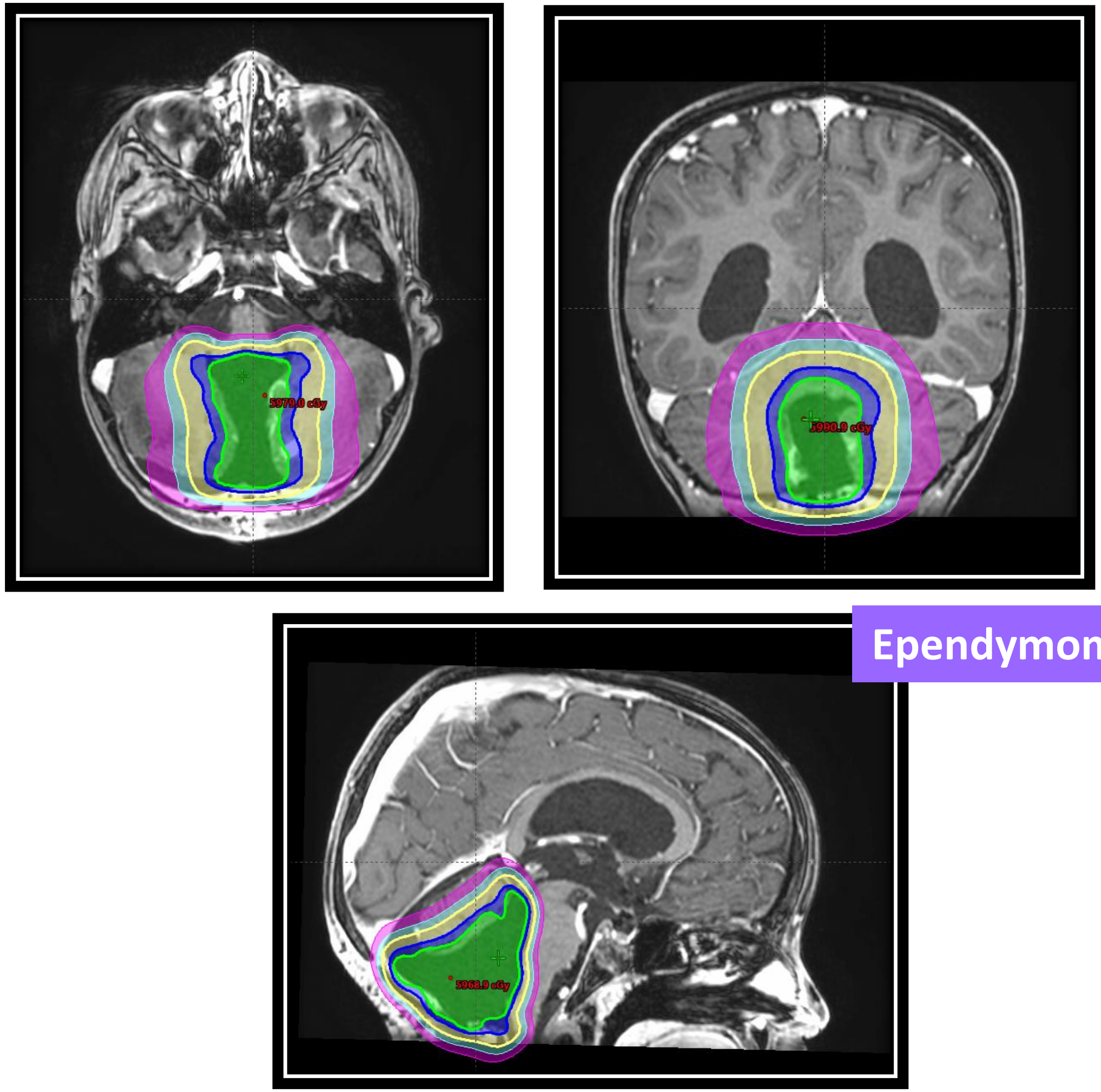


After 3 weeks – RE-simulation

# Re-irradiation



Leiomyosarcoma



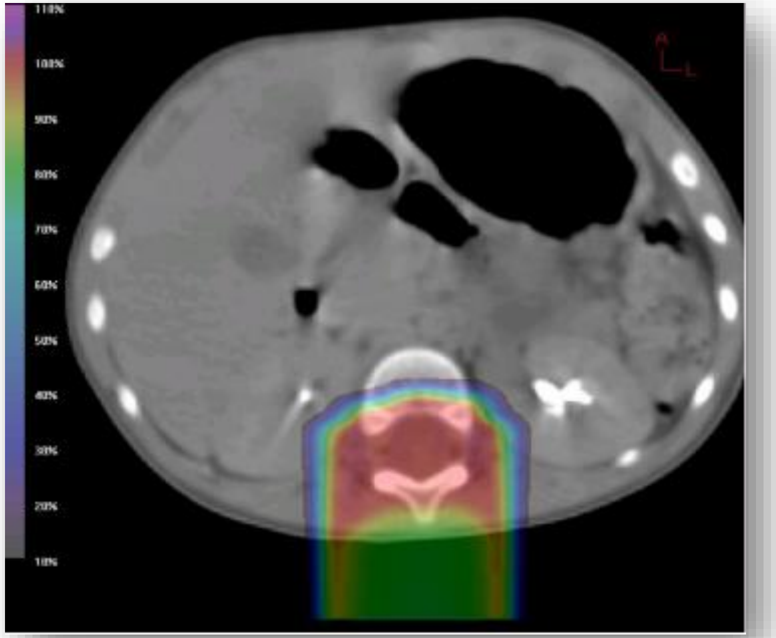
Ependymoma

# Outline

- Why proton therapy in pediatric patient?
- Treatment outcome of proton therapy in pediatric CNS tumor
- Experience of proton therapy in pediatric patient (KCMH)
- Challenging of proton therapy in pediatric cancer

# Vertebral body dose in Craniospinal Irradiation

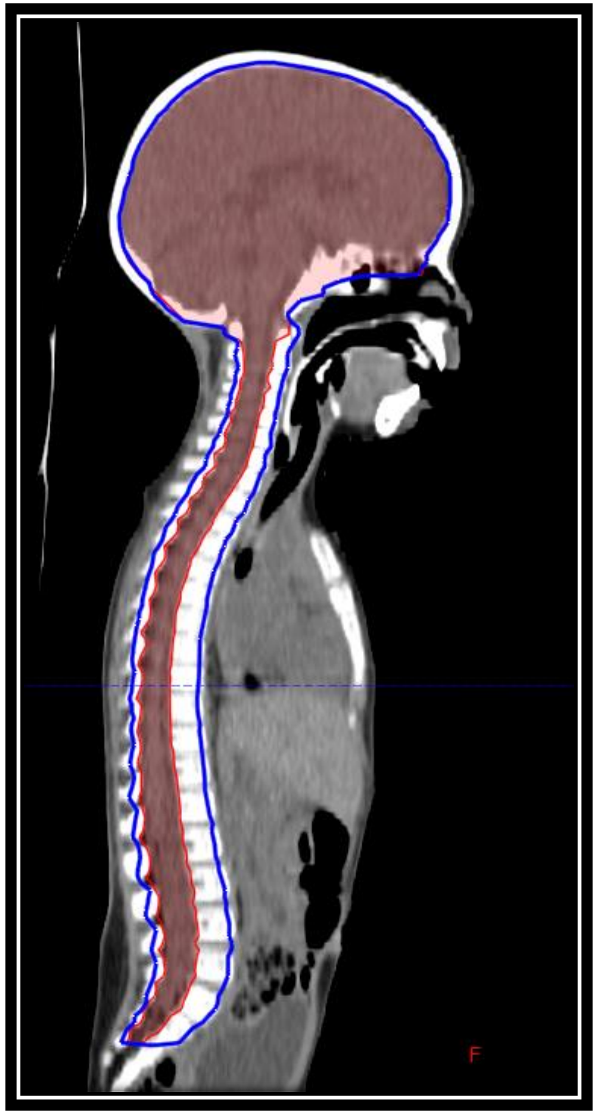
Vertebral body sparing



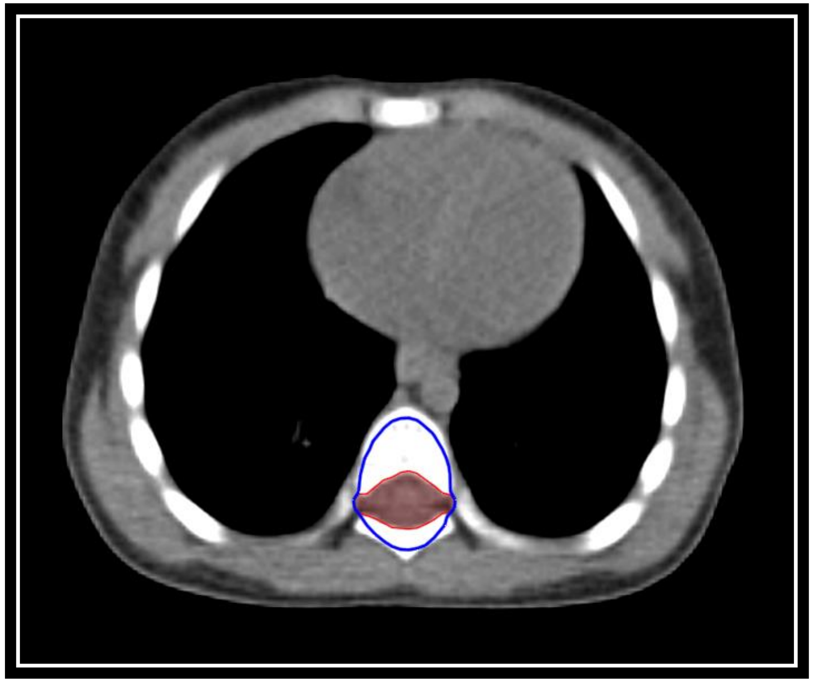


*MacEwan I, et al. Advances In Rad Oncol 2017*

# Craniospinal Irradiation: Reduced-dose vertebral body



**CSI/vertebral body dose**
- **23.4/18 Gy**
- **36/20 Gy**



# Challenging of proton therapy in pediatric patient

- Vertebral body dose in CSI
- Brain stem necrosis

# Brainstem injury in Posterior fossa Pediatric Brain tumor

- Brain stem injury rate
  - Photon : 0-6.7%
  - Proton : 2-16%

- Is there a different tolerance of the brainstem between XRT and PRT?
  - Variation of RBE at the Bragg peak
- COG ACNS 0831 protocol, Brainstem dose criteria

| | XRT | PRT |
|---|---|---|
| D50% | ≤ 6,100/6,200 cGy | ≤ 5,240/5,400 cGy |
| D10% | ≤ 6,300/6,400 cGy | ≤ 5,660/5,800 cGy |

Goal/Maximum

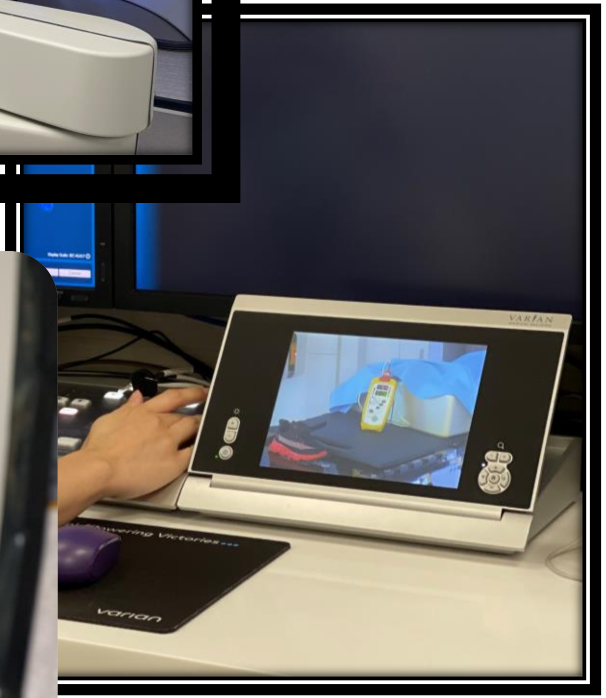
- PBT techniques – multiple beam arrangement, IMPT

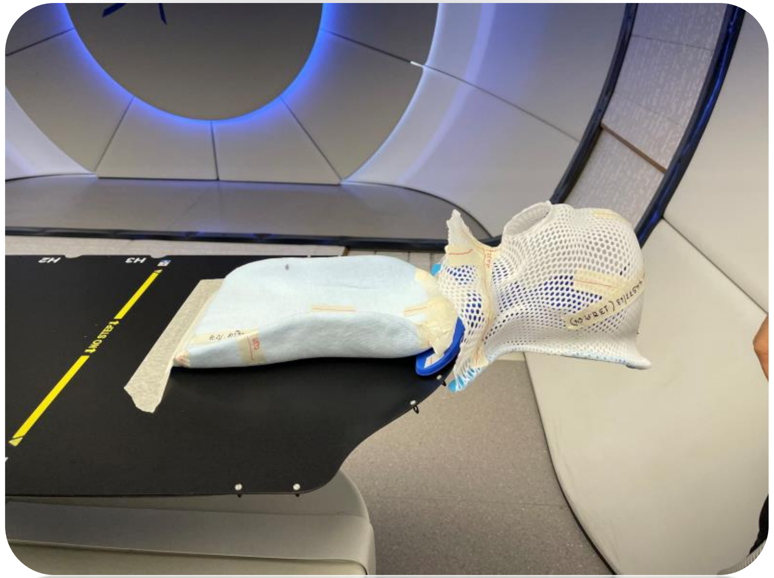
*https://classic.clinicaltrials.gov/ProvidedDocs/68/NCT01096368/Prot_SAP_000.pdf*

# Challenging of proton therapy in pediatric patient

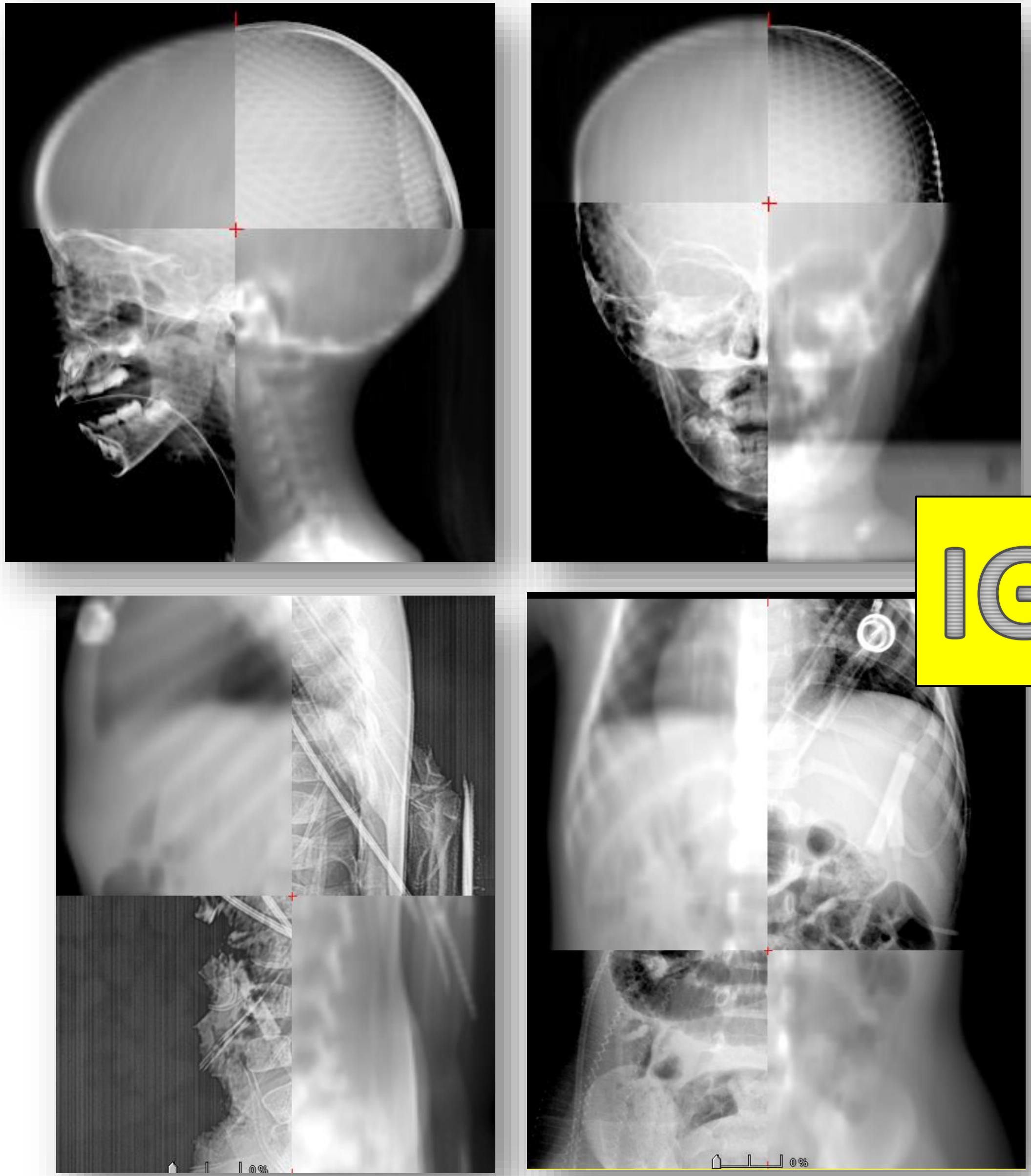
- Vertebral body dose in CSI
- Brain stem necrosis
- Spend longer time in the treatment room
  - Need sedation and general anesthesia
  - IGRT

# General Anesthesia



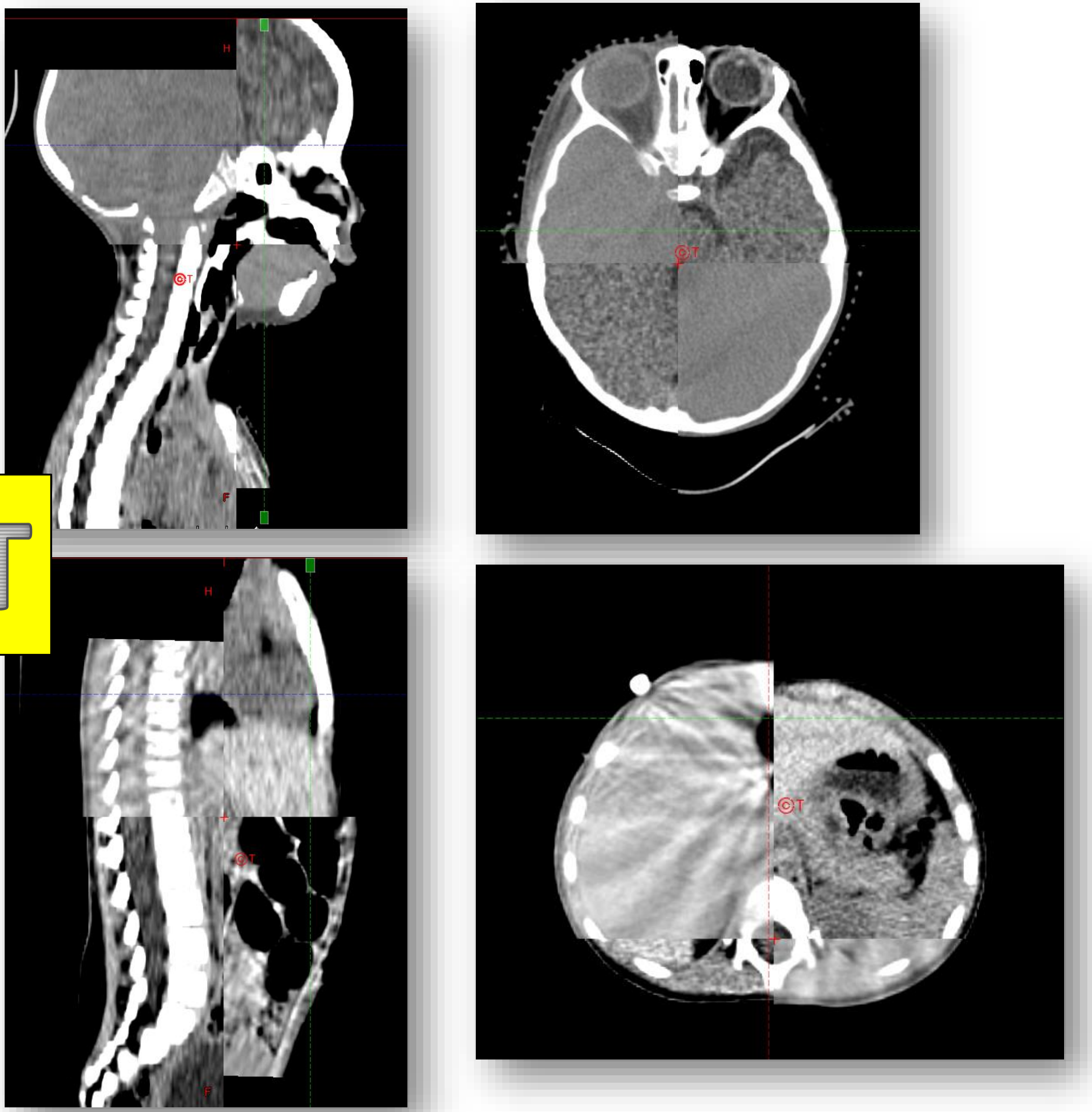


## KV Image



## IGRT

## CBCT



# Challenging of proton therapy in pediatric patient

- Vertebral body dose in CSI
- Brain stem necrosis
- Spend longer time in the treatment room
  - Need sedation and general anesthesia
  - IGRT
- Treatment cost

**Her Royal Highness Princess Maha Chakri Sirindhorn Proton Center**
**Division of Radiation Oncology**
**King Chulalongkorn Memorial Hospital**




อัตราค่าบริการสาธารณสุขเพื่อใช้สำหรับการเบิกจ่ายค่ารักษาพยาบาลในสถานพยาบาลของทางราชการ
หมวดที่ 8 ค่าตรวจวินิจฉัยและรักษาทางรังสีวิทยา

<u>ลำดับที่ 8.8.48</u> การฉายรังสีโปรตอน

(Proton Beam Therapy)

ใช้สำหรับข้อบ่งชี้ ดังนี้

1. เนื้องอกและมะเร็งในเด็ก (อายุไม่เกิน 15 ปี) ที่หวังหายขาด
(Primary or benign solid tumors in children treated with curative intent)

2. เนื้องอกและมะเร็งที่ไม่สามารถรักษาด้วยรังสีเอกซ์/โฟตอนได้อย่างปลอดภัย เนื่องจากมีโอกาสเกิดภาวะแทรกซ้อนที่เป็นอันตรายต่อชีวิต (CTCAE ความรุนแรงระดับ 4-5)
(Tumors that cannot be achieved with OARs constraint by photon due to possibility of life-threatening complications (CTCAE grade 4-5 complications))

## ข่าวดี บอร์ด สปสช. อนุมัติสิทธิประโยชน์ "รักษามะเร็งด้วยอนุภาคโปรตอน"

แชร์ ฐานเศรษฐกิจ

25 ธันวาคม 2566


**บอร์ด สปสช. อนุมัติสิทธิประโยชน์รักษามะเร็งฉายแสงด้วยอนุภาคโปรตอน ดูแลผู้ป่วยมะเร็งสิทธิบัตรทอง จ่ายชดเชยค่าบริการเหมาจ่าย 50 ล้านบาท/ปี ให้แก่ รพ.จุฬาลงกรณ์ ซึ่งให้บริการรักษาด้วยอนุภาคโปรตอนเพียงแห่งเดียวของไทย**

ทั้งการ**รักษามะเร็งด้วยอนุภาคโปรตอน**เป็นวิธีรักษามะเร็งที่มีประสิทธิผล มีอัตราการควบคุมโรคเฉพาะที่และการรอดชีวิตที่สูงในกลุ่มโรคมะเร็งสมองในเด็ก ช่วยลดผลข้างเคียงในทุกด้านเมื่อเปรียบเทียบกับการฉายรังสีโฟตอนแบบเดิม โดยการรักษาต้องใช้บุคลากรทางการแพทย์และผู้เชี่ยวชาญประกอบด้วย แพทย์รังสีรักษา แพทย์รังสีวินิจฉัยแพทย์เวชศาสตร์นิวเคลียร์ กุมารแพทย์ทางโลหิตวิทยาและรังสี (กรณีผู้ป่วยเด็ก) วิสัญญีแพทย์ นักฟิสิกส์การแพทย์ นักรังสีเทคนิค พยาบาล และวิศวกร

# Conclusion

- Proton beam therapy in pediatric cancer
  - Comparable treatment outcome
  - Decrease dose to adjacent normal tissues
    - Expected to improve treatment-related side effect
  - Lower integral dose
    - Potential to reduce risk of secondary malignancy

- Challenging
  - Treatment technique
  - Treatment cost

ProBEAM

PRT
PRT

รายละเอียดช่องทางการบริจาค
ช่องทางที่ 1
บริจาคผ่าน
ระบบ E-Donation*
โดยสแกน QR Code
ผ่าน Mobile Banking
Application ได้ทุกธนาคาร
ช่องทางที่ 2
บริจาคด้วยเงินสด
โอนเงิน หรือเช็ค
ติดต่อ คุณ ธนัญญา วงษ์ชมภู
เพื่ออำนวยความสะดวกในการนำเงินบริจาคเข้าบัญชี
และการออกใบเสร็จรับเงิน โทร 02-2564000 ต่อ 60725
ขอบคุณที่เป็นส่วนหนึ่ง
ของอนาคตที่สดใส
ของพวกเราครับ/ค่ะ
ติดต่อสอบถามข้อมูลเพิ่มเติมได้ที่
โทร 02-2564000 ต่อ 60725
อีเมล์ chulacancer@yahoo.com
วันจันทร์ถึงศุกร์ เวลา 8.00 - 16.00 น.
เงินสด หรือโอนเงิน
หรือเช็คผ่านธนาคาร
ศูนย์โปรตอนสมเด็จพระเทพรัตนราชสุดาฯ
Her Royal Highness Princess Maha Chakri Sirindhorn Proton Center
ส่งต่อโอกาส
มอบอนาคต
ให้ผู้ป่วยมะเร็งในเด็ก
ร่วมบริจาค
เพื่อสมทบทุนโครงการเฉลิมพระเกียรติ
สมเด็จพระกนิษฐาธิราชเจ้า
กรมสมเด็จพระเทพรัตนราชสุดาฯ สยามบรมราชกุมารี
ให้การรักษาโรคมะเร็งสมอง
ในผู้ป่วยเด็กด้วยอนุภาคโปรตอน

PROTON
PROTON

# Thank you