Proton Therapy for Pediatric Cancers

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Pediatric Cancers: What is Proton therapy?

- Three main types of treatment for tumors
  - Surgery – to remove the tumor
  - Chemotherapy – to travel through the entire body and kill cancer cells
  - Radiation therapy
    - Use of high energy particles or waves to kill cancer cells
    - Directed at the area where the tumor is or was
      - Only works where its aimed
      - Only causes side effects where it’s aimed
      - The goal of every radiation oncologist is to deliver the radiation where it is needed, and not anywhere else
Pediatric Cancers: What is Proton therapy?

- “Standard” or “regular” radiation uses X-rays
- X-rays do not have mass or charge and travel through the patient

- Protons are heavy and positively charged – thus they **STOP** within tissues
- With careful planning, we can determine the stopping point
  - Protons allow sparing of more healthy, normal tissue

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Pediatric Cancers: What is Proton therapy?

![Graph showing relative absorbed dose vs depth in water with Bragg peak and SOBP indicated](image-url)
Pediatric Cancers: What is Proton therapy?

- Many pediatric solid tumors require radiation
  - Brain tumors
    - Medulloblastoma
    - Ependymoma
    - Rhabdoid tumors
    - Astrocytomas
  - Solid and liquid tumors of childhood
    - Rhabdomyosarcoma
    - Ewings sarcoma
    - Neuroblastoma
    - Hodgkin Disease
    - Wilms Tumor
Proton Therapy and Pediatrics: Brain Tumors

Kumar, JPHO, 2013
Proton Therapy and Pediatrics: Brain Tumors

- Mathematical models suggest decreased neurocognitive impact of RT based on less interval dose
- Requires clinical verification

Proton Therapy and Pediatrics: Rhabdomyosarcoma
Proton Therapy and Pediatrics: Clinical Practice

Hill-Kayser et al, ASTRO 2013

Proton Therapy and Pediatrics
Rhabdomyosarcoma

Acute Toxicities Experienced by Pediatric Patients Undergoing Proton Therapy for Head & Neck Cancers

Number of Patients

Dehydration  Dermatitis  Dry Mouth  Dysgeusia  Dysphagia  Esophagitis  Fatigue  Neck Edema  Vocal Changes

None  Grade 1  Grade 2  Grade 3  Grade 4
Proton Therapy and Pediatrics: Spinal Ewing Sarcoma

- Spinal Ewing Sarcoma
- Allows elimination of exit dose through heart and lungs

Proton Therapy and Pediatrics: Neuroblastoma
Proton Therapy and Pediatrics: Hodgkin Lymphoma

- Stage I-II Hodgkin Disease requiring mediastinal radiation

- Survival approaches 95%
  - Mantle radiation is strongly associated with:
    - **Stroke risk**: RR late-occurring stroke 5.62 (95% CI, 2.59 to 12.25; P < .0001) (Bowers, JCO, 2005)
    - **Heart disease**: Increased risk of bypass, need for cardioverter defibrillator or pacemaker, valve surgery, and pericardial surgery (Galper, Blood, 2011)
    - **Breast cancer risk**: RR breast cancer 6.2 if > 40 Gy, 2.6 for <40 Gy (Tinger, IJROBP, 1997)
  - Also associated with **lung cancer risk** (van Leeuwen, JCO, 1994)

Proton Therapy and Pediatrics: Hodgkin Lymphoma

- Newer approaches to HD radiation have reduced these risks
  - Reduction in normal tissue exposure through blocking normal tissue and decreasing overall dose
  - Leads to decreased heart, lung, and breast dose

![Diagram of classic mantle, blocking of axillary regions, and blocking of high neck regions.](image-url)
Proton Therapy and Pediatrics: Hodgkin Lymphoma

Proton Therapy and Pediatrics: Research

- Cooperative group studies
- Children’s Oncology Group
- Pediatric Proton Collaborative Registry
- Institutional Clinical Trials
  - Hypothesis: Proton radiation will increase cure rates while sparing normal brain and reducing NC deficits
  - Study objectives:
    - To assess development based 2 years post-RT with other later objectives to be measured
  - Funded study available nationally
Proton Therapy and Pediatrics: Conclusions

- Proton therapy offers recognized normal tissue sparing expected to translate to decreased late effects for treatment of many childhood cancers
- We are well-positioned to conduct high-quality research, and this is absolutely necessary
  - Registry studies and institutional experiences
  - Prospective trials asking new questions
    - Higher doses? Novel uses? Novel techniques?
  - Collaboration is essential

PROTON THERAPY AND PEDIATRIC CANCERS
Psychosocial and Family Concerns
Psychosocial Considerations

- Providing support to:
  - Patients
  - Caregivers
  - Siblings

- Child Life Specialists: Certified professionals who work with patients and families to reduce the stress and anxiety that may be associated with the hospital experience.

- Psychosocial Support Team: Social Work, Nurses, Physicians, Nurse Management, Nurse Practitioners

Considering the Pediatric Patient

- Past medical experiences
- Relocation/separation
- Schooling
- Side-effects
Procedural Preparation

• Factors to Consider:
  • Position for treatment
  • Area targeted for treatment
  • Separation anxiety
  • Differentiating “holding still”
  • Support for Patients Getting GA

Coping with Treatment and Side-Effects

• Factors to Consider:
  • Where patients are in their cancer treatment journey
  • Time of day being treated
  • Anesthesia v. no anesthesia

• Challenges:
  • Procedural support
  • Side-effects of anesthesia
  • Radiation burns, nausea, fatigue
  • Compliance
Promoting Coping

• Normalizing the environment
• Providing developmentally appropriate play
• Medical play
• Therapeutic activities

Considering the Family

Potential Stressors for Families

• Financial Strain
• Relocation/Limited Support
• Schooling
• Family Restructuring
Providing Support to Families

- When separated: promoting communication (Skype/FaceTime, letters/journaling, creating art, scrapbooks)
- Through shared space: connecting family to family (while maintaining boundaries)
- Encouraging self-care and routine
- Team approach to partnering with families
- Siblings: prep, education, coping
- Assisting with transitions

THANK YOU!

Questions?