Preliminary Experience with Proton Radiotherapy for Pelvic Bone Sarcomas


Radiation Oncology
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Bone Sarcomas

• Surgery is used for the treatment of the primary lesion for most patients with bone sarcomas
  – Acceptable margins difficult to achieve in the axial skeleton including skull, spine, sacrum, and pelvis
  – These are sites where radiation can be an important component of local control
Radiation Dose- Sarcomas

- **Chondrosarcomas and Osteosarcomas**
  - Microscopic residual disease \(\sim 66\) Gy
  - Gross residual disease \(\geq 70\) Gy

- **Chordomas**
  - Microscopic residual disease \(\sim 70\) Gy
  - Gross residual disease \(\geq 75\) Gy
Pelvic Bone Sarcomas

• Surgical morbidity can be high for lesions involving the acetabulum: Hoffman et al. (Munster, Germany)
  – Hindquarter amputation
    • 0/8 able to ambulate in the community
  – Limb salvage surgery is extensive and can have local complications and functional consequences.
    • Endoprosthetic replacement had better function
      – 4/10 able to ambulate in the community (p=0.015)
    • While patients could adapt to their new living conditions, significant interventions were necessary for them to deal with problems such as restricted mobility or changing jobs or job orientation
Pelvic Bone Sarcomas

• Radiation Therapy
  – Conventional RT for pelvic sarcomas can also cause morbidity
  – In young patients (median age 14.5) undergoing RT in conjunction with chemotherapy for pelvic Ewing sarcoma, significant late effects including muscular atrophy and limb length growth delay have been reported (Paulino et al. Pediatr Blood Cancer 2006;18:18.)
  – Rx planning studies have shown that protons deliver superior target dose coverage and better sparing of normal tissues than 3D-CRT or IMXT for pelvic sarcomas (Lee et al. IJROBP 2005. 63:362).
  – As dose-volume parameters are expected to correlate with acute and late toxicity, protons should receive serious consideration as the preferred technique for the treatment of these tumors
Local recurrence-free survival (skull base)

- **Histology**

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<tr>
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<th>Chondrosarcoma</th>
<th>Chordoma</th>
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<tbody>
<tr>
<td>5 years</td>
<td>98 %</td>
<td>73 %</td>
<td>&lt;.0001</td>
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<tr>
<td>10 years</td>
<td>95 %</td>
<td>54 %</td>
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_Courtesy: John Munzenrider, MGH/HCL_
Harvard Medical School

Sarcomas of the Spine

- Hug et al. (Harvard Cyclotron Laboratory)
  - Photon/proton XRT +/- resection 1980-1992
    - 47 pts: osteogenic/chondrogenic axial skeletal tumors
    - XRT: Post-op (n=23), Pre + post-op (n=17), XRT only (7)
      - Group I: Chordoma/Chondrosarcoma n=20
        - Mean 73.9 CGE 5 Year LC 53%/100%
      - Group II: Osteosarcoma n=15
        - Mean 69.8 CGE 5 Year LC 59%
      - Group III: Giant cell tumor, osteo or chondroblastoma n=12
        - Mean 61.8 CGE 5 Year LC 83%
    - Trend to improved LC: primary, > 77 Gy, less residual
Materials and Methods

- **Patient Selection:** Three patients who declined radical surgery for peri-acetabular chondrosarcomas.

- **Methodology:** Retrospective chart review of 3 patients with peri-acetabular chondrosarcomas managed with primary radiation therapy after biopsy or curettage/packing without radical surgery.
Patient Characteristics

- **Age**: Range: 33-58 years (Median: 39)
- **Sex**: Males 3
- **Tumor location**: Acetabulum: 2
  Acetabulum and ilium: 1
- **Grade**: Grade 1/3: 2
  Grade 1-2/3: 1
- **Tumor size**: 3.6-14 cm
  Median 3.7 cm
- **Stage (AJCC)**: IA: 2
  IB: 1
Treatment

• Surgery
  – Curettage/Packing: 2
  – Needle Biopsy: 1

• Radiation Therapy
  – Protons 74 GyE/ 37 fx
    • CTV: 50 GyE/ 25 fx
    • GTV boost 24 GyE/ 12 fx

• Follow-up after XRT
  – 16-36 months
  – Median: 36 months
Pelvic Chondrosarcoma

Managed by curettage, autografted bone, and protons 74 GyE in 37 fx
Pelvic Chondrosarcoma

No evidence of progressive disease at 36 months.
Pelvic Chondrosarcoma

Managed by curettage, cement packing, and protons 74 GyE in 37 fx
Pelvic Chondrosarcoma

Managed by biopsy and protons 74 GyE in 37 fx.
No evidence of progressive disease 16 months after treatment.
Results

- All patients completed proton therapy without significant acute morbidity.
- With follow-up of 16-36 months, there has been no tumor progression or late morbidity.
- Patients #1 and #2 with the smaller peri-acetabular lesions are symptom-free, ambulating normally (cycling, hiking) without need for assistive devices or pain medication, and working full time 36 months after treatment.
- Patient #3 with 14 cm lesion no longer needs narcotic pain medication, uses a cane, and works part-time.
Discussion

• Protons can deliver high radiation doses to pelvic sarcomas with little morbidity to date and might offer an alternative if radical surgery is declined.
• We are interested in treating a larger number of patients using this approach.
• Patients with chondrosarcoma, osteosarcoma, malignant fibrous histiocytomas (MFH) of bone, and Ewing’s sarcoma.
Discussion

• Pediatric patients with sacral/pelvic Ewing’s and osteosarcoma are currently being treated with concurrent chemoradiation on a protocol at our center for non-rhabomyosarcoma soft tissue and bone sarcomas (P.I. T. Yock MD)
  – ChemoRT is an accepted modality for Ewing sarcoma
  – Recent data suggest high rates of local control (11/11) and disease free survival (10/11) in extremity osteosarcoma patients who respond to chemotherapy
Discussion

• Propose similar study for adult patients to undergo proton therapy for local tumor control following biopsy or conservative resection.
  – Would be interested in collaboration with other centers
• Except for the case of chondrosarcoma, patients would also receive appropriate systemic chemotherapy.
• Endpoints will include local tumor control, disease-free and overall survival, functional outcome, and acute and late complications.