**Background**

- Patients with high-risk bladder cancer (pT3+ or N+) have a substantial risk of locoregional failure after neoadjuvant chemotherapy and radical cystectomy. In SWOG 8710, the rate of locoregional recurrence for patients with pT3+ disease ranged from 19 – 41%. 
- An ongoing prospective phase-II trial (NCT01954173) is examining the role of postoperative photon radiotherapy (RT) for high-risk patients using photon-based volumetric modulated arc therapy (VMAT) [2].

**Results**

- Increased mean PBM dose (Gy) was associated with greater nadirs in WBC (Pearson CC 0.593, p=0.015) and ANC (Pearson CC 0.597, p=0.024).
- Increased PBM volume (%) receiving 30 Gy (Pearson CC 0.618, p=0.011) and 40 Gy (Pearson CC 0.512, p=0.043) was associated with greater WBC nadir.
- Increased PBM volume (%) receiving 20 Gy (Pearson CC 0.569, p=0.034) and 30 Gy (Pearson CC 0.588, p=0.024) was associated with greater ANC nadir.

**Methods**

- The outcomes of 18 patients enrolled to date on NCT01954173 were retrospectively analyzed following pelvic radiation per protocol to 50.4 or 55.8 Gy in 28 or 31 fractions.
- Nadirs of white blood cell (WBC), absolute neutrophil count (ANC), absolute lymphocyte count (ALC), and platelets were correlated with PBM dose using Pearson correlation.
- Comparative PBT plans were generated using pencil beam scanning with a 3-beam multi-field optimization technique with two opposed lateral fields and a PA field.
- Plans were developed to treat the predefined protocol clinical target volume (CTV) + 0.2 cm with robust optimization to include an additional 0.5 cm of setup uncertainties in all directions and 4% range uncertainty.
- Pelvic bone marrow was disdicated by contouring all pelvic bones from the ilium to the proximal femur and cropping out the cortical bone.

**Results (cont.)**

- Compared to VMAT plans (A), comparative IMPT plans (B) decreased the mean PBM dose from 28.5 Gy to 18.1 Gy (p<0.001) and had significant reductions in the volume of PBM receiving doses from 5-40 Gy.

**Conclusions**

- Greater mean PBM dose was correlated with lower hematologic nadirs in these patients receiving pelvic radiotherapy.
- PBT plans reduced PBM dose and may be a valuable strategy to reduce the risk of hematologic toxicity in these patients.
- Prospective comparative studies are needed to quantify the magnitude of clinical benefit.

**References**

1. Cristofanilli M et al. Optimizing bladder cancer surgical delay: its evaluation after radical cystectomy using SWOG 8710
3. Association of hematologic toxicity of IMPT with a phase II trial of comparative PBT for urogenital cancer. JSAP2012
4. et al. Association between bone marrow acoustic properties and acute hematologic toxicity in rectal cancer patients treated with concurrent chemotherapy and intensity-modulated radiotherapy. JSAP2009

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**Table 1. Baseline Characteristics**

<table>
<thead>
<tr>
<th>Race</th>
<th>Age (yr)</th>
<th>Histology</th>
<th>pT</th>
<th>ypT</th>
<th>ypN</th>
<th>Surgical</th>
<th>pN</th>
<th>ypN</th>
<th>Median, cm (+/- SD)</th>
<th>Complete Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>77 (+/- 19.9)</td>
<td>Squamous</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>None</td>
<td>0</td>
<td>0</td>
<td>77 (+/- 19.9)</td>
<td>100%</td>
</tr>
<tr>
<td>Black</td>
<td>32 (+/- 6)</td>
<td>Adenocarcinoma</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>Partial</td>
<td>1</td>
<td>0</td>
<td>32 (+/- 6)</td>
<td>100%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>45 (+/- 30)</td>
<td>Transitional</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>None</td>
<td>0</td>
<td>0</td>
<td>45 (+/- 30)</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Table 2. Association of Mean Blood Counts Before and After RT**

<table>
<thead>
<tr>
<th>Before RT (± SD)</th>
<th>After RT (± SD)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC (10^9/L)</td>
<td>7.21 (+/- 1.31)</td>
<td>4.20 (+/- 1.11)</td>
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<tr>
<td>ANC (10^9/L)</td>
<td>4.35 (+/- 1.52)</td>
<td>3.17 (+/- 1.14)</td>
</tr>
<tr>
<td>ALC (10^9/L)</td>
<td>1.83 (+/- 0.59)</td>
<td>0.64 (+/- 0.25)</td>
</tr>
<tr>
<td>Platelets (10^12/L)</td>
<td>293.64 (+/- 114.37)</td>
<td>219.38 (+/- 112.35)</td>
</tr>
</tbody>
</table>

**Table 3. Correlations of PBM Volumes and Count Nadirs**

**Table 4. Dosimetric Comparison of PBM and RT plans**

**Figure 1:** Schema of NCT01954173 phase II trial

**Figure 2:** Axial CT slices with radiation dose color wash from 10 – 50.4 Gy for an example patient with the (A) delivered VMAT plan and a (B) comparative PBT plan. This patient with high-risk bladder cancer received postoperative radiotherapy to 50.4 Gy.