Target and Pelvic Lymph Nodal Delineation: Gynecologic IMRT

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Target Delineation
The Heart of IMRT
Target Delineation

- Step 1 Identify treatment volume
- Depends on the tumor site, disease stage, histology, pathologic features
- Most pts receive pelvic RT
- More comprehensive volumes used in select patients
  - Stage IIIC uterine cancer → EFRT
  - Papillary serous uterine cancer → WART
  - Vulvar cancer → Pelvic-inguinal RT
Target Delineation

• Step 2 Identify individual components of the treatment volume
• More difficult step
• Controversial which components to include
• No consensus even among experts
Gynecologic IMRT Working Group

- Established in 2004
- Brought together physicians and physicists interested in gynecologic IMRT
- Develop consensus guidelines on how gynecologic IMRT should be planned and delivered
- 45 institutions in the USA, Canada, Europe, South America, New Zealand, and Asia
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<thead>
<tr>
<th>Gynecologic IMRT Working Group</th>
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<tr>
<td>Albert Einstein</td>
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<td>Centre GF Leclerc (France)</td>
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<td>Chiba Cancer Center (Japan)</td>
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<td>Clinia de Navarra (Spain)</td>
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<td>Erasmus MC-Daniel den Hoed (Dutch)</td>
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<td>Leiden University (Netherlands)</td>
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<td>Mallinckrodt (Wash U)</td>
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<td>Northwestern University</td>
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<td>Princess Margaret Hospital (Canada)</td>
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Gynecologic IMRT Working Group

- Member survey noted considerable differences
- In adjuvant pelvic IMRT, all include vagina (upper ½), cervix/uterus (if present), parametria, internal and external iliac lymph nodes
- Most (72%) include the common iliac nodes
- Major difference involved pre-sacral nodes
  - All include pre-sacral nodes in cervical cancer pts but ½ respondents excluded them in endometrial cancer

Mell LK et al.
Gynecologic IMRT Working Group: Practice Survey
ASTRO (2004)
Target Volume Components
IM-Pelvic RT Patients

Vagina
Upper 1/2
Cervix/uterus (if present)
Parametria tissues
Pelvic Lymph Nodes
Common, internal and external iliacs
Pre-sacral nodes

In all cervical cancer and uterine cancer with cervical involvement
Target Delineation

• Step 3 Decide *how* to contour the target
• Most difficult step

While two physicians may agree on the components of the CTV, they rarely agree on how to contour them.
Consensus Guidelines

• Guidelines for target design are being developed
• At least for post-operative pelvic IMRT

GOG-RTOG-ESTRO-NCIC
Target Consensus Meeting
Philadelphia June 2005
Post-hysterectomy CTV
www.rtog.org
RTOG 0418 (Jhingran)

Guidelines based on participants’ opinions and published data
Consensus Guidelines for the Delineation of the CTV in the Postoperative Pelvis in Patients with Endometrial and Cervical Cancer

Loren Mell, William Small Jr., Carien Cruetzberg, Anuja Jhingran, Mahesh Varia, Jen De Los Santos, Penny Anderson, David Gaffney, Lorraine Portelance, Tracey Schefter, Arno J. Mundt

LYMPHANGIOGRAM-ASSISTED LYMPH NODE TARGET DELINEATION FOR PATIENTS WITH GYNECOLOGIC MALIGNANCIES

K. S. Clifford Chao, M.D., and Mary Lin, B.S.
Department of Radiation Oncology, Washington University Medical School, St. Louis, MO

Chao KS et al. *Int J Radiat Oncol Biol Phys* 2002;54:1147-1152
Fe Oxide nano-particle enhanced MRI

Taken up in benign lymph nodes by macrophages

Target Delineation

- Only a clinical target volume (CTV) is delineated (postoperative setting)
- Lymph node regions not delineated with a symmetric expansion around vessels
- 0.7 cm margin* used to encompass surrounding fat and connective tissues
- Normal tissues help define CTV extent
  - Psoas/piriform muscles, bowel and bones

*I prefer 1 cm
Target Delineation

Knowledge of pelvic anatomy very important

Poor knowledge of normal pelvic anatomy will result in poor target delineation
Anatomy

- IVC Bifurcation
- Right Common Iliac Artery
- Left Common Iliac Artery
- Descending Colon
- Bowel
- Psoas
- L5
- Iliac Crest
- Ascending Colon
Anatomy

- Iliac Crest
- Psoas
- Right Common Iliac V ein
- Right External Iliac Artery
- Right Internal Iliac Artery
- S2 nerve root (in pelvic sacral foramen)
- Iliacus
- Bifurcating Vessels
- S1 nerve root (in pelvic sacral foramen)
- Right Common Iliac Vein
Anatomy

- Psoas Muscle
- R External Iliac Artery
- R External Iliac Vein
- R Internal Iliac Artery
- R Internal Iliac Vein
- Sigmoid
- S2
Mons Pubis
Femoral Artery and vein
Urethra
Vagina
Anus
Start CTV contours ~1.5 cm below L4-5 (remember it will be expanded)
CTV is initially small and conical
As vessels bifurcate, it takes on a “bow tie” appearance
Use psoas muscle, small bowel and lumbosacral spine to help define CTV extent.
CTV inferiorly becomes U-shaped, encompassing lateral pelvic nodes and posterior presacral region.
In endometrial cancer pts without cervical extension, \textit{split} the CTV excluding presacral region.
Psoas and piriform muscles are helpful
At the level of the vaginal cuff, The CTV takes on a “bow tie” appearance.
Target Delineation
Myself vs Consensus Conference

- I favor inclusion of 1 cm of bladder and rectum in the CTV
- Yes it goes **against** the CTV concept!
- Provides a more generous margin around the vaginal cuff due to concerns over organ motion*
- Currently, I am exploring 2 approaches to tighten up margins around vaginal cuff

*Another 1 cm expansion is then added to form the PTV
Image-Guided IMRT
May be particularly useful in intact cervix pts
given the regression of tumors during treatment
“Integrated Target Volume”

- Creative solution to the organ motion problem developed at MDAH
- Two planning scans: one with a full and one with an empty bladder
- Scans are fused
- *Integrated target volume* (ITV) is drawn on the *full* bladder scan (encompassing the cuff and parametria on both scans)
- ITV is expanded by 0.5 cm → PTV_{ITV}
Cautionary Note

Avoid contouring the PTV directly
CTV-PTV is a 3-D expansion!!!
Not always 1 cm on each axial slice

Note the more generous expansion posteriorly (due to the rapidly changing CTV contour)
Inferiorly, the CTV “bow tie” appearance becomes more pronounced.
RTOG Atlas
Much tighter
CTV gradually transitions from a “bow tie” to cylindrical shape.
Target Delineation

• Step 4 Identify and contour normal tissues
• Controversial which normal tissues to include
• No consensus even among experts
Normal Tissues

- Normal tissues depend on the clinical case
- In most patients:
  - Small bowel, rectum, bladder
- In pts receiving concomitant or sequential chemotherapy, bone marrow may be included
- Some centers include the femoral heads*
- Kidneys and liver included only if treating more comprehensive fields

*I only do in pelvic-inguinal RT cases
Normal Tissues

• Be consistent with contouring
  – Helps with DVH interpretation
• **Rectum**: Outer wall (anus to sigmoid flexure)
• **Small bowel**: Outermost loops from the L4-5 interspace
  – Include the colon above the sigmoid flexure as well in the “small bowel” volume
• **Bone marrow**: iliac crests
  – Intra-medullary space
Normal Tissues

- Dip small bowel contour into concave CTV
- ↑ Conformity reducing small bowel dose

Bone Marrow
Initially contoured intramedullary canal of crests
Recently, outer surface of crests (certainly faster!)
BM-Sparing IMRT

Still unclear whether this is the right approach.

New data suggests that *solely* sparing crests may not be correct.
BM-Sparing IMRT

- Dosimetric analysis of factors associated with acute hematologic toxicity
- 37 cervical cancer pts treated with IM-pelvic RT plus CDDP (40 mg/m²/week)
- Major predictors of hematologic toxicity were
  - Total pelvic BM V-10 and V-20
  - Lumbar sacral spine V-10 and V-20
- Not volume of the iliac crests

Mell LK, Roeske JC, Mundt AJ
Int J Radiat Oncol Biol Phys 2006;66:1356
## BM-Sparing IMRT

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<th>&lt;90%</th>
<th>≥90%</th>
<th>p-value</th>
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<tr>
<td><strong>No. patients</strong></td>
<td>18</td>
<td>19</td>
<td></td>
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<tr>
<td><strong>Grade ≥2 leukopenia</strong></td>
<td>11%</td>
<td>74%</td>
<td>&lt; 0.01</td>
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<td><strong>Grade ≥2 neutropenia</strong></td>
<td>6%</td>
<td>32%</td>
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<tr>
<td><strong>Grade ≥2 anemia</strong></td>
<td>6%</td>
<td>22%</td>
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<tr>
<td><strong>Any thrombocytopenia</strong></td>
<td>22%</td>
<td>53%</td>
<td>0.057</td>
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Mell LK et al. ASTRO 2005
Int J Radiat Oncol Biol Phys 2006;66:1356

Prospective clinical trial
Cervical cancer patients IM-PRT + cisplatin (40 mg/m²/week)
Constraints on V-10 and V-20 total marrow
V10 ≤ 90%, V20 ≤ 75%
Conclusions

Target volume definition is a very important and time-consuming aspect of gynecologic IMRT.

Knowledge of normal anatomy and patterns of drainage essential in optimal target delineation.