Target
in post operative cancer cervix

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Learning objectives

• Knowledge of basic anatomy, lymphatic and pattern of spread in cervical cancer

• To understand the definition of CTV in post operative case of cervical cancer.

• To know the delineation of normal tissue / organ at risk in post operative case of cervical cancer.

• Importance of target definition in radiotherapy planning in post operative case.
Anatomy: Cervix

- Fundus
- Body
- Isthmus
- Cervix
- Ostium
- Vagina
- Lig. of ovary
- Uterine tube
- Ovary
- Round lig.
- Broad lig.
- Fimbriae
- Fornix of vagina
Laterally:  
Obturator → Int. iliac (Hypogastric LNs) → Ext iliac & Common iliac LNs → Para aortic

Anteriorly:  
Ext. iliac LNs

Posteriorly:  
Sacral → Common iliac & Para aortic LN
Patterns of spread: Cervical cancer

Local Spread: Adjacent structure & organs

Lymphatic Spread: Pelvic & Para Aortic Nodes

Distant Spread
Treatment options

Surgery
Radiotherapy
Chemotherapy
Incidence of Lymph Nodes mets. after radical hysterectomy

- 208 cervical cancer patients
- Stage IB-IIB

<table>
<thead>
<tr>
<th>Clinical Stage</th>
<th>Number of patients</th>
<th>Pelvic LN mets. Number (%)</th>
<th>Para aortic LN mets. Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I B</td>
<td>96</td>
<td>11 ( 11.5 )</td>
<td>2 ( 2.15 )</td>
</tr>
<tr>
<td>II A</td>
<td>15</td>
<td>4 ( 26.7 )</td>
<td>0</td>
</tr>
<tr>
<td>II B</td>
<td>97</td>
<td>38 ( 39.2 )</td>
<td>7 ( 7.2 )</td>
</tr>
</tbody>
</table>

Sakuragi et al Cancer 1999;85:1547-54
Indications for Pelvic RT post op

- Most common failure pattern following radical surgery for cervical cancer is pelvic relapse.

- Factors affecting higher failure rate include:
  - Positive lymph nodes
  - Large primary tumor
  - Involved surgical margins
  - Lympho-vascular space invasion
  - Depth of stromal invasion
CTV: Postoperatively

• **Parametrial & paravaginal tissues:** Vaginal cuff to medial edge of internal obturator muscle/ischial ramus both side

• **Vagina:** Upper 1/2 = Vaginal cuff and 3cm of vagina inferior to cuff

• **Regional Lymph nodes:** Pelvic & Presacral LN

• **Controversies in upper extent of LN drainage:** 72% include Common iliac nodes (*Mell LK et al; ASTRO 2004*)
4 Field Box Pelvic RT

- Conventional RT irradiation of large volumes of normal tissues → multiple acute and chronic toxicities
  - Small bowel: SBO, enteritis, malabsorption
  - Rectum: Proctitis, rectal bleeding
  - Bone Marrow: ↓se WBC, ↓se platelets, anemia
  - Pelvic Bones: Insufficiency fractures, femoral head necrosis
If you know the target......

Conformation reduces volume of small bowel in upper pelvic region while bladder and rectum in lower pelvis to receive high doses
RTOG-GOG-ESTRO-NCIC
Consensus Guideline

• RTOG (June 2006), a consensus conference on target design was held.

• Developed guidelines for CTV in postoperative cervix and endometrial cancer patients treated by pelvic IMRT

• Atlas on RTOG website
Lymph nodes Delineation

Aorta
Inf. Vena Cava
Psoas Muscle
Lymph nodes Delineation

Aortic Bifurcation = Common iliacs

CTV: Add 7-mm margin around the Common iliac vessels.
Extend to include any visible or suspicious lymph nodes, lymphoceles and pertinent surgical clips.
CTV should be modified to exclude the vertebral body, psoas muscle and bowel.
Lymph nodes Delineation

CTV to extend posterior and lateral borders to psoas ms. and vertebra
Pelvic Lymph nodes Delineation

Bifurcation of Cl artery to External & Internal iliac artery

CTV: Add 7-mm margin around the External and Internal iliac vessels
CTV: Bow tie appearance
Pelvic Lymph nodes Delineation

CTV: includes **presacral LN** In all cervical and endometrium ca. with cervical extend 10-15mm strip drawn anterior to vertebral body at S1 and S2 level. U shaped appearance. Bladder and rectum included when CTV overlap these structures.
Pelvic Lymph nodes Delineation

Lower Presacral Lymph Nodes

Lower Presacral Nodes included in CTV
if tumor extension into uterosacral ligaments or rectal involvement
Pelvic Lymph nodes Delineation

iliacus ms.  Psoas ms.  Piriformis ms  Int. iliac vessels  Ext. iliac vessels
Pelvic Lymph nodes Delineation

At Obturator LN level: CTV expand to 17mm wide strip from pelvic wall
Pelvic Lymph nodes Delineation

Lateral Ext. iliac nodes: 34-45% missed by conventional fields. However, rare site of recurrence. May not be routinely included in Nodal CTV. Included only if Ext. iliac Nodes involved or if target includes inguinal region. Extend anterolaterally 10mm along iliopsoas ms.
Pelvic Lymph nodes Delineation

Inguinal Lymph nodes

Parametrial tissue

Parametrial & paravaginal tissues

Vaginal cuff to medial edge of internal obturator muscle/ischial ramus both side

Internal iliac Nodal CTV terminate at

Level of vaginal cuff.

Cranial section of coccygeal ms.
Pelvic Lymph nodes Delineation

Ext iliac Nodal CTV terminate at
- Level of superior aspect of femoral head
- Translation point of Ext iliac vein from post to medial position to femoral A.
Pelvic Lymph nodes Delineation

Lower vaginal region:
CTV cylindrical in shape
Normal tissue contouring (OAR)

- No consensus among experts
- Normal tissue contoured in most patients
  - Small bowel, rectum, bladder
- In patients receiving chemotherapy with radiotherapy bone marrow may be included
  - Femoral heads esp in pelvic-inguinal RT,
  - Kidneys and Liver in more comprehensive field
Normal tissue contouring (contd..)

- Be consistent in delineation: it helps in DVH interpretation
- **Bladder**: Outer wall
- **Rectum**: Outer wall: From recto-sigmoid junc. to just above anal verge or upper limit of anal canal
- **Small bowel**: Outer most loops; colon included in “small bowel” above recto-sigmoid junction
- **Bone / Bone Marrow**: outer Iliac crest/ Intra-medullary canal of crest + Lumbo-sacral spine
Normal tissue contouring (contd..)

Dip small bowel contour into concavity of CTV / sacral hollow
PTV definition

• Margins to account for
  ✓ Uncertainties in patient positioning and alignment at daily treatment
  ✓ Physiological changes in size, shape and position of Organ at risk as well as tumor during course of treatment
  ✓ Avoid contouring the PTV directly. CTV-PTV is a 3-D expansion
IMRT vs. 4 field box Planning
Dose: 45 Gy @ 1.8Gy/Fraction

Colon
Urinary bladder
Rectum
## IMRT: Planning studies

Decrease volume receiving prescription dose

<table>
<thead>
<tr>
<th>Authors</th>
<th>Bowel</th>
<th>Bladder</th>
<th>Rectum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roeske</td>
<td>↓50%</td>
<td>↓23%</td>
<td>↓23%</td>
</tr>
<tr>
<td>Ahamad</td>
<td>↓40-63%*</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Chen</td>
<td>↓70%</td>
<td>↓**</td>
<td>↓**</td>
</tr>
<tr>
<td>Selvaraj</td>
<td>↓52%***</td>
<td>↓36%***</td>
<td>↓66%***</td>
</tr>
</tbody>
</table>

*dependent on PTV expansion used
**data not shown
***reduction in percent volume receiving 30 Gy or higher

Roeske et al. *Int J Radiat Oncol Biol Phys* 2000;48:1613
Ahamad et al. *Int J Radiat Oncol Biol Phys* 2002;54:42
Chen et al. *Int J Radiat Oncol Biol Phys* 2001;51:332
## Clinical outcome studies

<table>
<thead>
<tr>
<th>Authors</th>
<th>N</th>
<th>Stage</th>
<th>Median FU</th>
<th>DFS</th>
<th>Pelvic Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kochanski</td>
<td>18</td>
<td>I-II (N+)</td>
<td>21m</td>
<td>79% 3yr</td>
<td>94%</td>
</tr>
<tr>
<td>Chen</td>
<td>33</td>
<td>I-II (N+)</td>
<td>35m</td>
<td>NS</td>
<td>93%</td>
</tr>
</tbody>
</table>

Significant decrease in both acute and chronic GI, GU related toxicities

*Kochanski et al., IJROBP 2005; 63:214*

*Chen et al., IJROBP 2001; 51: 332*
Issues that need to be addressed......

- CTV delineation
- Optimal CTV-PTV margin
- Organ motion issues
- Which normal tissues should be avoided?
- Presently CT used, integration of other novel imaging (MRI, PET, MRS, NanoMRI) for better target and normal tissues delineation
Thank You