Rectal Cancer: Management Overview

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Associate Professor
Radiation Oncology
12/11/19
Outline

• How is rectal cancer diagnosed and evaluated?
• Why is radiation considered for the care plan?
• What is radiation therapy, and how is it delivered?
• How are radiation, chemotherapy, and surgery integrated as part of the care plan for locoregionally advanced rectal cancer?
• What are the side effects of treatment, with a focus on radiation therapy?
• What is the patient experience entail from the time of consultation to treatment completion?
• What are some main concerns with rectal cancer survivorship?
Rectal Cancer: Signs/Symptoms

- Abdominal or rectal pain
  - May be associated with tenesmus
    - Feeling of incomplete defecation, accompanied by pain, cramping, and straining
- Change in bowel habits
  - Thinner stools
  - Incomplete emptying
  - Diarrhea and/or constipation
    - Quantify # of bowel movements at presentation & before symptoms started
- Gastrointestinal (GI) bleeding
- Fatigue/Anemia
- Weight loss
Work-Up

- Colonoscopy with Biopsy
- Rigid proctoscopy/Sigmoidoscopy
  - Establish distance of tumor from anus/sphincter
  - Abdominoperineal resection (APR) vs low anterior resection (LAR)
- Chest/abdomen/pelvic CT (ideally with contrast)
- Labs:
  - CBC, CMP, & the cancer marker CEA
- Pelvic MRI and/or Endoscopic Ultrasound (EUS)
- Enterostomal therapist as indicated for pre-op marking of ostomy site & teaching
- PET/CT not routinely indicated
T-Stage: Depth of Invasion

- **T-stage**
  - Depth of invasion starting from intestinal lumen
  - Not based on size
Rectal Nodal Distribution

Draining nodal regions:

- All patients
  - Internal iliac
  - Mesorectal
  - Presacral

- If tumor invades anterior organ (T4b)
  - External iliac b/c drains anteriorly located organs like uterus/prostate/bladder
Rectal Staging AJCC 8th Edition

<table>
<thead>
<tr>
<th>AJCC 8th</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Tumor invades submucosa</td>
</tr>
<tr>
<td>T2</td>
<td>Tumor invades muscularis propria</td>
</tr>
<tr>
<td>T3</td>
<td>Tumor invades through muscularis propria into pericolorectal fat</td>
</tr>
<tr>
<td>T4a</td>
<td>Tumor penetrate to the surface of the visceral peritoneum</td>
</tr>
<tr>
<td>T4b</td>
<td>Tumor invades or is adherent to other organs or structures</td>
</tr>
<tr>
<td>N1a</td>
<td>1 node</td>
</tr>
<tr>
<td>N1b</td>
<td>2-3 nodes</td>
</tr>
<tr>
<td>N1c</td>
<td>Tumor deposit(s) in subserosa, mesentery, or non-peritonealized pericolic or perirectal tissues without regional nodal mets</td>
</tr>
<tr>
<td>N2a</td>
<td>4-6 nodes</td>
</tr>
<tr>
<td>N2b</td>
<td>≥7 nodes</td>
</tr>
<tr>
<td>M1a</td>
<td>Distant mets confined to one organ or site without peritoneal metastases</td>
</tr>
<tr>
<td>M1b</td>
<td>Mets in &gt;1 organ/site or in the peritoneum without peritoneal metastases</td>
</tr>
<tr>
<td>M1c</td>
<td>Mets to peritoneal surface alone or with other organ mets</td>
</tr>
</tbody>
</table>
Rectal Staging AJCC 8th Edition

Always refer to the specific chapter for rules on clinical and pathological classification of this disease.

<table>
<thead>
<tr>
<th>When T is...</th>
<th>And N is...</th>
<th>And M is...</th>
<th>Then the stage group is...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tis</td>
<td>N0</td>
<td>M0</td>
<td>0</td>
</tr>
<tr>
<td>T1, T2</td>
<td>N0</td>
<td>M0</td>
<td>I</td>
</tr>
<tr>
<td>T3</td>
<td>N0</td>
<td>M0</td>
<td>IIA</td>
</tr>
<tr>
<td>T4a</td>
<td>N0</td>
<td>M0</td>
<td>IIB</td>
</tr>
<tr>
<td>T4b</td>
<td>N0</td>
<td>M0</td>
<td>IIIC</td>
</tr>
<tr>
<td>T1–T2</td>
<td>N1/N1c</td>
<td>M0</td>
<td>IIIA</td>
</tr>
<tr>
<td>T1</td>
<td>N2a</td>
<td>M0</td>
<td>IIIA</td>
</tr>
<tr>
<td>T3–T4a</td>
<td>N1/N1c</td>
<td>M0</td>
<td>IIIA</td>
</tr>
<tr>
<td>T2–T3</td>
<td>N2a</td>
<td>M0</td>
<td>IIIB</td>
</tr>
<tr>
<td>T1–T2</td>
<td>N2b</td>
<td>M0</td>
<td>IIIB</td>
</tr>
<tr>
<td>T4a</td>
<td>N2a</td>
<td>M0</td>
<td>IIIC</td>
</tr>
<tr>
<td>T3–T4a</td>
<td>N2b</td>
<td>M0</td>
<td>IIIC</td>
</tr>
<tr>
<td>T4b</td>
<td>N1–N2</td>
<td>M0</td>
<td>IIIC</td>
</tr>
<tr>
<td>Any T</td>
<td>Any N</td>
<td>M1a</td>
<td>IVA</td>
</tr>
<tr>
<td>Any T</td>
<td>Any N</td>
<td>M1b</td>
<td>IVB</td>
</tr>
<tr>
<td>Any T</td>
<td>Any N</td>
<td>M1c</td>
<td>IVC</td>
</tr>
</tbody>
</table>

- **Stage II**
  - Tumor invades through muscular wall of rectum (T3-T4)
- **Stage III**
  - Positive lymph nodes (N+)
- **Stage IV**
  - Metastatic disease (M+)
Work-up/Staging

Stage IIA (T3 N0 M0)

(Left) Colonoscopy shows a non-obstructing polypoid mass in the distal, anterior rectum in a 36-year-old woman who presented with hematochezia. On rigid proctoscopy, it is 6.5 cm from the anal verge. Biopsy revealed a moderately differentiated adenocarcinoma. (Right) Endorectal ultrasound (7.5 and 10 MHz) shows a 4 cm lesion extending through the rectal wall into adventitia (T3). No peritumoral adenopathy was identified.
Work-up/Staging:
T3 Disease

- MRI T2-weighted images: Tumor intermediate in intensity
Work-up/Staging: T4b Disease

Stage IIIC (T4b N2a M0)

(left) Flexible sigmoidoscopy in a 26-year-old man who presents with rectal pain and bleeding shows friable, infiltrated mucosa in the rectum, extending proximally from the anorectal junction. Biopsy confirmed adenocarcinoma. (Right) Endorectal ultrasound (7.5 and 10 MHz) shows a large rectal mass invading into the prostate, evidenced by the loss of the fat plane between the structures.

Stage IIIC (T4b N2a M0)

(left) Axial CECT in same patient shows circumferential thickening of distal rectum and anal canal. Note the perirectal stranding with fat plane loss between posterior bladder, prostate, and right seminal vesicle with the mass. (Right) Axial T2WI FSE MRI in same patient shows T3 hyperintense tumor at the right anterolateral anorectum with invasion of perirectal musculature and seminal vesicles. There is an eroded node of Cloquet.
Pattern of Failure: University of Minnesota

1974 - Retrospective study
- 74 patients with rectal adenocarcinoma
- All but 1 was T3-4 or LN(+) at initial curative resection
  - 91% Abdominoperineal resection
- Second or Symptomatic look surgery 6-12 mos. later
- Repeated Third & Fourth times

No post-op RT or chemo

70% eventually recurred
- Of those patients, 40% by 7 months, 85% by 2 years, 98% by 4 years

<table>
<thead>
<tr>
<th>Pattern of Failure</th>
<th>Only failure</th>
<th>Any</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local/Regional</td>
<td>48%</td>
<td>92%</td>
</tr>
<tr>
<td>Distant</td>
<td>8%</td>
<td>50%</td>
</tr>
<tr>
<td>Peritoneal seeding</td>
<td>0%</td>
<td>6%</td>
</tr>
</tbody>
</table>
Pattern of Failure:
University of Minnesota

- Pattern of failure in 52 pts.
  * = lung met
  † = liver met
  Δ = wound implant
  • = local failure
  O = lymph node failure

- Majority of recurrences would have been encompassed by a standard pelvic field
  - Delineated above by solid-lined octagon

- CONCLUSIONS
  - Vast majority (92%) of failures for T3/4 or N+ rectal cancer have locoregional component
  - Pelvic radiation may prevent these recurrences

Gunderson & Sosin; Cancer. 34:1278-1292, 1974
What is Ionizing Radiation?

Unit for Ionizing Radiation Dose = Gy = Joule/Kilogram
1 Gy = 100 cGy
How does radiation kill cancer cells?

- Photon ejects electron from atom

- Indirect Action (75%)
  - Electron breaks up H₂O into ions
  - Water ions damage DNA

  OR

- Direct Action (25%)
  - Electron damages DNA
How Radiation Works

• Radiation damages DNA of healthy cells & cancer cells

• Healthy cells stop trying to divide & repair the damage

• Cancer cells try to divide and can’t complete cell division
  – DNA is too abnormal so they die a mitotic death
    • i.e. they die while trying to perform cell division (a.k.a. mitosis)
Why Give Radiation: Dutch Trial = TME +/- RT

- **Eligibility Criteria**
  - Non-metastatic rectal adenocarcinoma
  - ≤15 cm from anal verge
- **119 centers enrolled from 1996 - 1999**
  - 1748 patients total
  - 1382 patients with R0 circumferential margin
- **Schema:** +/- Short Course RT
  (5 x 5 Gy to pelvis)
  - ≤1 week
  - Total Mesorectal Excision (TME)
Dutch Results: Benefit in Local Control

- Median f/u 11.6 years
- 6% benefit in local control for all patients
  - Larger benefit for more advanced stages
- No benefit to overall survival or preventing distant mets
Distant Spread Locations

**INITIAL SITE OF RECURRENCE**

<table>
<thead>
<tr>
<th>Location</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver</td>
<td>14%</td>
</tr>
<tr>
<td>Lung</td>
<td>9%</td>
</tr>
<tr>
<td>Local Regional</td>
<td>9%</td>
</tr>
<tr>
<td>Intraabdominal</td>
<td>8%</td>
</tr>
<tr>
<td>Retroperitoneal</td>
<td>4%</td>
</tr>
<tr>
<td>Peripheral Lymph Node</td>
<td>2%</td>
</tr>
</tbody>
</table>

## Summary of Effect of Adjuvant Treatment on Outcome

<table>
<thead>
<tr>
<th></th>
<th>Overall Survival</th>
<th>Local Recurrence</th>
<th>Distant Metastases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemo RT</td>
<td>↑ 10-15%</td>
<td>↓ 10-15%</td>
<td>↓ 10-15%</td>
</tr>
<tr>
<td>Chemo</td>
<td>↑ 10%</td>
<td>0</td>
<td>↓ 10-15%</td>
</tr>
<tr>
<td>RT</td>
<td>0</td>
<td>↓ 5-10%</td>
<td>0</td>
</tr>
</tbody>
</table>
When to Give RT?
Pre-op vs. Post-op

• Eligibility Criteria
  – ≤75 years old
  – Non-metastatic Rectal Adenocarcinoma
  – T3/4 or N+
  – ≤16 cm from anal verge

Schema:
Arm 1: Pre-op
  • XRT to 50.4 Gy /28 fractions → TME → 5-FU

Arm 2: Post-op
  • TME → XRT to 54 Gy → 5-FU
Outcomes of Pre/Post-op ChemoRT

- Median f/u 11.2 years
- Significantly more patients completed treatment in pre-op arm & had decreased local failure
- No difference in OS, distant mets free survival (DMFS), or disease-free survival (DFS) between arms
- Of local recurrences
  - 28% local alone & 72% also had mets
- **Less acute & late side effects with pre-operative therapy:** Favored CRT $\rightarrow$ S $\rightarrow$ C

Sauer et al. JCO 2012
# Common Side Effects

<table>
<thead>
<tr>
<th>Acute</th>
<th>Late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatigue</td>
<td>Minor persistent fatigue</td>
</tr>
<tr>
<td>Skin irritation/erythema</td>
<td>Increased bowel movement frequency</td>
</tr>
<tr>
<td>Abdominal cramping</td>
<td>Increased bowel movement urgency</td>
</tr>
<tr>
<td>Abdominal bloating</td>
<td>Sexual dysfunction</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>Decreased Libido</td>
</tr>
<tr>
<td>Increased flatulence</td>
<td>Menopause</td>
</tr>
<tr>
<td>Frequent urination</td>
<td>Infertility</td>
</tr>
<tr>
<td>Nausea</td>
<td>Vaginal dryness</td>
</tr>
<tr>
<td>Loss of appetite</td>
<td>Vaginal narrowing</td>
</tr>
<tr>
<td>Mild pain</td>
<td>Pain with intercourse</td>
</tr>
<tr>
<td>Worsening/development of hemorrhoids</td>
<td>Impotence</td>
</tr>
<tr>
<td>Hair loss in radiated site</td>
<td>Orgasm Changes (decreased ejaculate)</td>
</tr>
<tr>
<td>Cytopenias (leukopenia, lymphopenia, and thrombocytopenia)</td>
<td></td>
</tr>
</tbody>
</table>
## Less Common Side Effects

<table>
<thead>
<tr>
<th>Acute</th>
<th>Late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomiting</td>
<td>Severe persistent fatigue</td>
</tr>
<tr>
<td>Mucous/Stool discharge/incontinence</td>
<td>Loss of bone density</td>
</tr>
<tr>
<td>Severe pain (e.g. from Sores/Ulcers on skin or near cancer)</td>
<td>Muscular stiffness/discomfort from fibrosis (tissue stiffening/scarring)</td>
</tr>
<tr>
<td>Rectal bleeding</td>
<td>Persistent urinary frequency/urgency/discomfort</td>
</tr>
<tr>
<td>Anemia which might require transfusion</td>
<td>Fecal incontinence (due to damage to pelvic nerves &amp; muscles)</td>
</tr>
<tr>
<td>Infections (fungal, viral, or bacterial)</td>
<td>Persistent sexual dysfunction</td>
</tr>
<tr>
<td>Severe diarrhea</td>
<td>Blood in ejaculate</td>
</tr>
<tr>
<td>Dehydration</td>
<td>Permanent hair loss</td>
</tr>
<tr>
<td>Death</td>
<td>Damage to the intestines that could require surgery to repair (e.g. perforation, fistula, adhesions, and obstruction)</td>
</tr>
<tr>
<td></td>
<td>Abnormal opening in internal organ (e.g. fissure) that could cause pain and bleeding (e.g. bowel including rectum [proctitis] or urinary [cystitis])</td>
</tr>
<tr>
<td></td>
<td>Tumor/cancer caused by radiation</td>
</tr>
<tr>
<td></td>
<td>Bone fractures</td>
</tr>
<tr>
<td></td>
<td>Death</td>
</tr>
</tbody>
</table>
Norwegian: Rectal Quality of Life (QOL)

- Patients received long course preoperative chemoradiation
- Comparable toxicity to short course

![Bar chart showing fecal incontinence](chart.png)

Fig. 1. Fecal incontinence for liquid stools in RT+ and RT− patients without stoma.
Norwegian: Male Sexual QOL

Table 2. International Index of Erectile Function Scores in irradiated (RT+) and nonirradiated (RT−) patients

<table>
<thead>
<tr>
<th>Domain (valid answers n, RT+/RT−)</th>
<th>RT+ group Mean (SD)</th>
<th>RT− group Mean (SD)</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sexual desire (n = 104/130)</td>
<td>2–10 5.0 (2.0)</td>
<td>2–10 5.4 (2.0)</td>
<td>0.23</td>
</tr>
<tr>
<td>Erectile function (n = 100/125)</td>
<td>1–30 6.9 (7.9)</td>
<td>1–30 14.3 (11.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Orgasmic function (n = 103/128)</td>
<td>0–10 2.9 (3.8)</td>
<td>0–10 5.2 (4.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Intercourse satisfaction (n = 32/65)</td>
<td>0–15 7.6 (3.5)</td>
<td>0–15 10.1 (2.8)</td>
<td>0.001</td>
</tr>
<tr>
<td>Overall satisfaction with sex life (n = 96/120)</td>
<td>2–10 4.3 (2.2)</td>
<td>2–10 5.7 (2.6)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

* Mann-Whitney U test.
† Patients who had sexual intercourse during the previous month.

- RT negatively impacted sexual function
- Associated with low serum testosterone
Norwegian: Female Sexual QOL

- Effect of RT
  - No change in libido
  - Increased dyspareunia (35% vs. 11%)
  - Increased vaginal dryness (50% vs. 24%)
  - Reduced vaginal dimension (35% vs. 6%)
    - Consider vaginal dilators post-RT
Multi-Institution Research Study Assessing RT (Closed to Accrual)

- Patients randomized to receive RT or not
- Hope is to preserve outcomes despite exclusion of RT
- Just recently closed to accrual
- Results are still pending
NCCN Guidelines Version 3.2018
Rectal Cancer
NCCN Evidence Blocks™

CLINICAL STAGE

NEOADJUVANT THERAPY
- Chemo/RT
  - Capecitabine/long-course RT or infusional 5-FU/long-course RT (category 1 and preferred for both) or
  - Bolus 5-FU/leucovorin/long-course RT or
  - Short-course RT
- Chemotherapy
  - FOLFOX (preferred) or CAPEOX (preferred) or
  - 5-FU/leucovorin or capcitabine

PRIMARY TREATMENT
- Consider restaging
- Transabdominal resection
- Resection contraindicated
- Restaging
- Transabdominal resection
- Resection contraindicated

ADJUVANT TREATMENT
- cT3, N0 before chemo/RT
- 5-FU/leucovorin or capcitabine or FOLFOX (preferred) or CAPEOX (preferred)
- Surveillance (See REC-11)
- Surveillance (See REC-11)
- Surveillance (See REC-11)
- Systemic therapy (See REC-F)
- Systemic therapy (See REC-F)

See Evidence Blocks on REC-6A

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Note: For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page EB-1.

Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.
NCCN Guidelines Version 3.2018
Rectal Cancer
NCCN Evidence Blocks™

CLINICAL STAGE

NEOADJUVANT THERAPY

<table>
<thead>
<tr>
<th>Chemo/RT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Capcitabine/long-course RT, infusional 5-FU/long-course RT (category 1 and preferred for both) or bolus 5-FU/leucovorin/long-course RT or RT.</td>
</tr>
<tr>
<td>• Short-course RT or chemotherapy (FOLFOX (preferred) or CAPEOX (preferred) or 5-FU/leucovorin or capcitabine)</td>
</tr>
</tbody>
</table>

T3, N any with clear circumferential margin (CRM) (by MRI, T1-2, N1-2)

PRIMARY TREATMENT

<table>
<thead>
<tr>
<th>Consider restaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transabdominal resection (h,u,v)</td>
</tr>
<tr>
<td>Resection contraindicated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5-FU/leucovorin or capcitabine or capecitabine or infusional 5-FU/RT (preferred) or bolus 5-FU/leucovorin/RT or Short-course RT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transabdominal resection (h,u)</td>
</tr>
<tr>
<td>Resection contraindicated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Surveillance (See REC-11)</th>
</tr>
</thead>
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<td>Surveillance (See REC-11)</td>
</tr>
</tbody>
</table>

ADJUVANT TREATMENTc,p,q
(6 MO PERIOPERATIVE TREATMENT PREFERRED)

5-FU/leucovorin or capcitabine or FOLFOX (preferred) or CAPEOX (preferred)

Systemic therapyw
(See REC-F)

See Evidence Blocks on REC-6A

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Note: For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page EB-1.

All recommendations are category 2A unless otherwise indicated.

Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.
Non-Operative Management Study (Closed to Accrual)

- All patients are considered for non-operative management
- Received either chemo or chemoRT first, but all therapy given before assessing response
- Closed to accrual
- Results pending
Active Research Protocol (NRG GI-002): Search for Novel Systemic Agents

- High risk patients
- Search for systemic agents to give with RT that may improve outcomes
- All patients receive systemic therapy (chemo, targeted agents, and/or immunotherapy), RT & surgery
Initial Consultation with Rad Onc:

- Discuss goals of care & specifically goals of RT
  - Improve local control?
  - Definitive therapy via non-operative management?
- Does patient want RT?
- If yes, consent patient
CT Simulation for RT Planning

- Position/Immobilize Patient
- Tattoos typically for daily setup/alignment
- Set initial borders of radiation treatment field(s)
Simulation Instructions & RT Targets

• CT Simulation
  – GOAL: Displace bowel superiorly out of field
    • Prone
    • Belly board
    • Full bladder
  – Anal marker to delineate anal verge
    • often for avoidance
  – Consider PO contrast if significant bowel volume falls into pelvis
  – Consider IV contrast if need help identifying nodes (rare)

• RT Plan
  – Usually 3D conformal
    • 3 or 4 fields
  – Consider IMRT for select cases
    • (nodal burden & small bowel issues)

(Left) During simulation, patient lies prone with arms up, on a belly board with downsloped back edge, pubic symphysis at edge of board aperture, and alpha cradle indexed to bottom of board. (Right) Sagittal CT shows the same patient, with full (350 mL) bladder (yellow), anal marker (green) at the verge, and rectal contrast in place. Small bowel (pink) is displaced superiorly and anteriorly by bladder distension and the belly board.

(Pelvic EBRT) PA DRR shows prep pelvic field with CTVs for presacral LN (orange), internal iliac LN (green), mesorectum (red), and pelvic floor (cyan). Classic field borders are sup.: L3-S1 junction, int.: 3 cm below GTV (or below obturator foramina, whichever is most int.), laterally: 1.5 cm from pelvic inlet. (Right) Lateral DRR in same patient shows CTVs. Classic borders are ant.: base of pubis for T3 (1 cm ant. to pubis for T4a) & post.: 1 cm behind ant. sacrum.
Simulation Instructions: Full Bladder to Protect Small Bowel

- 1 hour before simulation and treatment
  - Empty bladder & quickly drink 16 oz of water
  - Encourage pt to practice before the day of the sim to make sure they can hold urine for that long

Chen & Anker; Colon & Rectum from Radiation Oncology: Imaging and Treatment 2013
Empty Bladder Consequences

- Bowel falls into pelvic radiation fields
ANATOMY

**Aorta** bifurcates at L4

**Common Iliacs** bifurcate at L5/S1

**External Iliac Nodes** run in a straight line from L4/L5 to pubic symphysis (so to include give 2 cm sup margin On the aforementioned line), 1 cm ant to pubis, 3 cm ant to femoral head

**Internal Iliac Nodes** dive posteriorly (so to include ant border is at post margin of pubis, but give at least 2 cm on vertebral bodies!)

**Obturator nodes** lie anterior To internal iliac nodes, in sup lat Obturator foramen on AP film
### Fields using Bony Landmarks

<table>
<thead>
<tr>
<th>LAR</th>
<th>AP</th>
<th>Lateral (T3)</th>
<th>Lateral (T4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
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<table>
<thead>
<tr>
<th>APR</th>
<th>AP</th>
<th>Lateral (T3)</th>
<th>Lateral (T4)</th>
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<tbody>
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<td><img src="image5.png" alt="Diagram" /></td>
<td><img src="image6.png" alt="Diagram" /></td>
<td><img src="image7.png" alt="Diagram" /></td>
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- Larger fields if post APR
Perineal Scar Boost/Bolus

(Left) PA DRR shows postop RT field in the same patient with tumor located 2 cm from anal verge. This patient was placed supine due to ostomy. Initial CTV (orange) includes presacral LN, internal iliac LN, and boost CTV (red), which includes the preop CTV and APR scar (delimited by wire ). (Right) Lateral DRR shows sagittal projection of initial and boost CTVs. Inferior border is below the APR scar . Perineal scar was bolused every other day.
Dosimetry/Treatment Planning

Dosimetrists Perform

- Dose Calculation
- Dose/Plan Optimization
  - Plans take from hours if emergency (e.g. bleeding) up to 10 business days (IMRT)
What if Anterior Organ Invasion (T4b)?

- 3D Conformal RT fields shown above
- Increased bowel dose due to more anterior coverage
What is Intensity Modulated Radiation Therapy (IMRT)?

- Beam divided into hundreds of “beamlets”
- Computer treatment planning software optimizes beamlet intensities
- Allows fulfillment of challenging dose constraint requirements
- Uniform dose across entire beam

3D Conformal RT

IMRT
How is dose modulation accomplished for IMRT?

- Multi-Leaf Collimator is moving while the beam is on
- Most of the field is blocked at any time
When is IMRT helpful?

- IMRT best for concave targets
  - Can “paint” dose where needed, avoiding normal tissue such as bowel
When is IMRT not helpful?

- For this IMRT plan, dose is spread out into bowel and bladder
- 3D CRT is more efficient and less expensive
Additional Considerations: Avoiding the Ovaries

- Typically oophoropexy considered if ≤40 years old
- Still experience premature menopause
  - Timing may be estimated from dose received, as there is no safe RT dose that spares oocytes

Chen & Anker; Colon & Rectum from Radiation Oncology: Imaging and Treatment 2013
Quality Assurance

- Performed by Physicists
- Multiple confirmations that data transferred correctly
  - Planning computer → Linac
- Physicists may give a “dummy” treatment to a patient surrogate
  - a.k.a phantom, usually container of water
  - Confirms correct calculations of dose to be delivered to a patient
  - Important for IMRT
Treatment Console

- RT Plan is transferred to treatment machine consoles
- Therapists check for all required information/instructions
Treatment

- Both RT linear accelerator gantry and “couch” where patient lays can move
On-Treatment Visit

- Patients seen weekly by both nurse & physician
- Side effect management
  - Skin care, medical management, hydration, consider treatment breaks
- Emotional support/encouragement
Survivorship Considerations

- Develop long-term surveillance plan
  - Combination of H&P, CEA lab draws, CT chest/abdomen/pelvis scans, and colonoscopies
  - Routine CEA monitoring & CT scans not recommended past 5 years
- Bowel function changes
  - Chronic diarrhea, incontinence, stool frequency, stool clustering, urgency, cramping
    - Consider anti-diarrheals, bulk forming agents, diet manipulation, pelvic floor rehabilitation/physical therapy, and protective undergarments
  - Ostomy care
- Neuropathy
  - Consider duloxetine for painful neuropathy (not useful for numbness, tingling, cold sensitivity)
  - Consider referral to pain specialist for refractory cases
- Urogenital dysfunction
  - Screen for sexual dysfunction, erectile dysfunction, dyspareunia, and vaginal dryness
  - Screen for urinary incontinence, frequency & urgency
  - Consider referral to urologist or gynecologist for persistent symptoms
- Consider bone density monitoring due to potential for pelvic fractures
- Encourage healthy diet & exercise
  - Limit alcohol consumption (≤ 1 for women & ≤2 for men)
  - Consider daily aspirin 325 mg for secondary prevention
- Encourage continued therapeutic relationship with PCP
  - Help patient establish care with one if not presently involved

Adapted from NCCN Guidelines Version 3.2018
Summary

- Staging studies help establish a diagnosis, prognosis, and treatment options.
- Radiation preferentially kills cancer cells rather than normal tissue.
  - Advances in radiation technology are improving outcomes
  - Decreased toxicity and improved efficiency
- Multidisciplinary input is essential from the time of diagnosis through the follow-up period
- Treatment plans are individualized based on a patient’s goals and disease characteristics
- Encourage patients to seek and utilize the numerous resources available to support their care plan
Thank you!

• Questions?

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