TARGET VOLUME DELINEATION IN RECTAL CANCER

Dr Jayaprakash Madhavan
MD. DMRT. DNB, FICRO
Surgery for Rectal Cancer

Technical Failure Results in Local Recurrence

Circumferential Resection Margin

- In curative resected patients:
  - 23% overall local recurrence rate
    - 66% CRM involved
    - 8% CRM not involved
- Effect of CRM involvement on 5-year survival:
  - 62% overall survival
    - 24% CRM involved
    - 74% CRM not involved
    - \( p < 0.001 \)

Radial Margin

- The radial margin is defined as involved or positive when the shortest distance between the resection margin was less than 1 mm.
- Sources of circumferential margin involvement:
  - Primary tumor penetration
  - Lymphatic mesorectal spread
  - Mesorectal tumor deposits
TME for Rectal Cancer

- Remove rectum en bloc with mesorectum
<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>Treatment</th>
<th>Tumor downstaging* [% of patients]</th>
<th>pCR [% of patients]</th>
<th>5-year local recurrence rate [% of patients]</th>
<th>5-year OS [% of patients]</th>
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<tbody>
<tr>
<td>Swedish Rectal Cancer Trial (1997)</td>
<td>1,168</td>
<td>Preoperative short-course RT surgery (TME not mandated)</td>
<td>NR</td>
<td>NR</td>
<td>11.0</td>
<td>58.0</td>
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| German Rectal Cancer Study Group (2004) | 421 | Preoperative 5-FU + RT  
Postoperative 5-FU + RT | NR | 8.0 | 6.0 | 76.0 |
| EORTC 22921 (2005, 2006)             | 1,011 | Preoperative RT  
Preoperative RT + postoperative 5-FU  
Preoperative 5-FU + RT  
Preoperative 5-FU + RT + postoperative 5-FU | 42.4 ‡  
42.4 ‡  
57.1 §  
57.1 § | 5.3 ‡  
5.3 ‡  
13.7 §  
13.7 § | 17.1  
9.6  
8.7  
7.6 | 64.8 ‡  
64.8 ‡  
65.8 §  
65.8 § |
| FFCD 9203 (2006)                     | 733  | Preoperative RT  
Preoperative 5-FU + RT | NR | 3.6 | 16.5 | 67.9 |
| Dutch Rectal Cancer Study (2007)     | 1,861 | Preoperative short-course RT + TME only | NR | NR | 5.6 | 64.2 |

*Defined as T0–T2.  ‡Combined data from patients receiving preoperative RT with or without postoperative 5-FU.  §Combined data from patients receiving preoperative 5-FU + RT with or without postoperative 5-FU. Abbreviations: 5-FU, 5-fluorouracil; LARC, locally advanced rectal cancer; NR, not reported; OS, overall survival; pCR, pathologic complete response; RT, radiotherapy.
Pre-treatment evaluation

- Digital rectal examination
- Rigid Proctoscopy
- Endoscopic rectal uss
- MRI pelvis
- PET CT

Multidisciplinary Tumour Board
Transrectal Endoscopic Ultrasound (TEUS)
**Figure:** Normal rectal and perirectal anatomy on high-resolution T2-weighted MRI. Rectal mucosa (M), submucosa (SM), and muscularis propria (PM) are well discriminated. Mesorectal fascia appears as a thin, low-signal-intensity structure (*arrowheads*) and fuses with the remnant of urogenital septum making Denonvilliers fascia (*arrows*).

**Figure:** Mucinous adenocarcinoma of the rectum. T2-weighted MRI shows high signal intensity (*arrowheads*) of the cancer lesion in right anterolateral side of the rectal wall.

Assess the depth of invasion
MRI
PET- CT images fused with MRI
Contour BowelBag, Colon and SmallBowel the suggested cm above PTV, not necessarily this high.

Sagittal

PenileBulb
Bladder
SeminalVes
Prostate
Rectum
BowelBag

subtract any overlapping non-GI normal structures from BowelBag

PenileBulb has a rounded shape
Arrows, mesorectal fascia
Design and delivery of pelvic radiation

Anatomic location of the tumour
Pathways lymphatic spread
Patterns local relapse
Pre operative or post operative
Definitive chemo radiation
Pelvic radiation

<table>
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<th>Preoperative</th>
<th>Post operative</th>
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<tr>
<td>• Better anatomic delineation</td>
<td></td>
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<tr>
<td>• Bowel adhesions less</td>
<td></td>
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<tr>
<td>• Better oxygenated and biologically more effective</td>
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<tr>
<td>• Target volume is determined by operative findings and extent of surgery</td>
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<tr>
<td>• Bowel adhesions and small bowel radiations more</td>
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<td>• Less oxygenated and biologically less effective</td>
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Position

- Prone with belly board
- supine
Target volume conventional technique

- Lower limit – 2cm below the lower extent or pelvic floor which ever is lower
- Upper limit sacral promontory or some times L4-5 junction
- Laterally 1.5 cm lateral to medial pelvic rim
- Anteriorly just behind the pubic symphysis unless there is extension ant structures or anal canal involvement
- Posteriorly entire sacrum is included
Radiation Targets or Fields
Techniques of radiations

- Conventional - 3field technique with wedges or four field box technique
- Conformal
- 3D planning gives better and uniform target coverage than 2D and should be used
- Prefers 6Mv or more
Techniques of radiation

- IMRT or VMAT using image guided therapy
  highly conformal radiation with better homogeneity
  spare the healthy normal tissue and OAR
RTOG – IMRT

- **CTV A – ALWAYS TREATED**
  - Rectum and mesorectum (perirectal area)
  - Internal iliac nodes
  - Presacral area

- **CTV B**
  - External iliac nodal region

- **CTV C**
  - Inguinal nodal region
Group consensus contours: Brown = CTVA (peri-rectal, pre-sacral, internal iliac), Blue = CTVB (external iliac).
FIGURE 1. Superposition of individual investigator’s contours of clinical target volumes. Each contour was assigned a different color. These are best viewed with a zoom of 200%. 
Margin around blood vessels – 7-10mm
PTV margin -7mm-10mm
Boost volume

- 2cm margin
Techniques to minimize radiation side effects

Treated Prone with belly board and bladder distended
Anal sphincter sparing
conclusion

• Each centre should have protocol for imaging and integration of various imaging to assess the tumour in a multidisciplinary tumour board
• MRI pelvis should be a standard imaging to assess mesorectal involvement and lymph node metastasis
• Accurate knowledge of anatomy and spread pattern of the tumour improves target delineation
• IMRT and online imaging verification improves dose conformity and homogeneity and spares normal tissue and organ at risk.