Protocol of Radiotherapy for Esophageal Cancer

■ Indications for radiotherapy

1. Indications for preoperative chemoradiation (non-cervical esophagus):
   cT1b-cT2, N+ or cT3-cT4a, Any N
2. Indications for definitive chemoradiation
   A. For non-cervical esophagus
      I. T4b, any N, M0
      II. Patients who decline surgery
      III. Inoperable
   B. For cervical esophagus: recommended

3. Indications for postoperative chemoradiation
   A. For squamous cell carcinoma (if patients have not received
      preoperative chemoradiation)
      I. R1 or R2 resection
      II. pN+ (only indicated at Chi Mei Hospital, Liouying)
   B. For adenocarcinoma (if patients have not received preoperative
      chemotherapy or chemoradiation)
      I. T2N0M0: only for selected patients with high risk features
         (poorly differentiated, higher grade cancer, lymphovascular
         invasion, neural invasion, or <50 years of age or patients who did
         not undergo D2 lymph node dissection)
      II. T3-T4a, any N, M0
      III. Any T, N+, M0
      IV. R1 or R2 resection
   C. For adenocarcinoma (if patients have received preoperative
      chemotherapy)
      I. R1 or R2 resection

■ Simulation and Treatment Planning

1. CT simulation and conformal treatment planning should be used.
2. IMRT is appropriate in clinical settings where reduction in dose to organs at
   risk is required that cannot be achieved by 3-D techniques.
3. When clinically appropriate, use of IV and/or oral contrast for CT
   simulation may be used to aid in target localization.
4. Use of an immobilization device is strongly recommended for
reproducibility of daily set-up.

- **Target Volume**
  1. Gross Tumor Volume (GTV) is defined as all known gross disease as defined by the planning CT and clinical information. Gross tumor includes the primary tumor (GTV-P) and macroscopically involved lymph nodes (GTV-LN).
  2. Clinical Target Volume (CTV) includes the area of subclinical involvement around the GTV. We have chosen to define the CTV a minimum of 3-4 cm proximal and distal and 1 cm lateral beyond the GTV delineated by CT scan and/or endoscopy. All GTV-LN were included with a margin of 0.5-1.5 cm.
  3. Recommended elective treatment of node bearing regions depends upon the location of the primary in the esophagus.
    A. Cervical esophagus: Consider the supraclavicular nodes and consider treatment of higher echelon cervical nodes, especially if the nodal stage is N1 or greater.
    B. Proximal third of the esophagus: Consider para-esophageal lymph nodes and supraclavicular lymph nodes.
    C. Middle third of the esophagus: Consider para-esophageal lymph nodes.
    D. Distal third of esophagus and the gastro-esophageal junction: Consider para-esophageal, lesser curvature, splenic nodes, and celiac axis nodal regions.
  4. PTV expansion should be 0.5 to 1 cm. The uncertainties arising from respiratory motion should also be taken into consideration.

- **Radiation dose**
  1. Preoperative Therapy: 41.4-50.4 Gy (1.8-2 Gy/day).
  2. Postoperative Therapy: 45-50.4 Gy (1.8-2 Gy/day).
  3. Definitive Therapy: 50-50.4 Gy (1.8-2 Gy/day).
    A. Higher doses may be appropriate for tumors of the cervical esophagus, especially when surgery is not planned.
    B. Published studies have reported radiation doses from 60-66Gy. However, there is no randomized evidence to support any benefit or detriment of this dose range over 50-50.4 Gy (1.8-2 Gy/day).
Constraints of OAR

1. Lung dose may require particular attention, especially in the preoperatively treated patient. It is recognized that these dose guidelines may be appropriately exceeded based on clinical circumstances.

<table>
<thead>
<tr>
<th>Lungs</th>
<th>Left Kidney, Right Kidney</th>
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<tbody>
<tr>
<td>• (V_{30}) ≤ 10%</td>
<td>(evaluate each one separately):</td>
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<tr>
<td>• (V_{30}) ≤ 15%</td>
<td>• No more than 33% of the volume can receive 18 Gy</td>
</tr>
<tr>
<td>• (V_{30}) ≤ 20%</td>
<td>• Mean dose &lt; 18 Gy</td>
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<tr>
<td>• (V_{30}) ≤ 40%</td>
<td></td>
</tr>
<tr>
<td>• (V_{30}) ≤ 50%</td>
<td></td>
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<tr>
<td>• Mean &lt; 20 Gy</td>
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<tr>
<th>Cord</th>
<th>Liver</th>
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<tbody>
<tr>
<td>• Max ≤ 45 Gy</td>
<td>• (V_{20}) ≤ 30%</td>
</tr>
<tr>
<td></td>
<td>• (V_{20}) ≤ 20%</td>
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<tr>
<td></td>
<td>• Mean &lt; 25 Gy</td>
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<thead>
<tr>
<th>Bowel</th>
<th>Stomach</th>
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<tr>
<td>• Max bowel dose &lt; Max PTV dose</td>
<td>• Mean &lt; 30 Gy (if not within PTV)</td>
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<tr>
<td>• (D_{ts}) ≤ 45 Gy</td>
<td>• Max dose &lt; 54 Gy</td>
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<table>
<thead>
<tr>
<th>Heart</th>
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<tbody>
<tr>
<td>• (V_{30}) ≤ 30% (closer to 20% preferred)</td>
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<tr>
<td>• Mean &lt; 30 Gy</td>
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References


