Radiotherapy Guideline for Non-Small Cell Lung Cancer

中山醫學大學附設醫院 放射腫瘤科

(2024.09 Version 9.0)

RT indication

1. General principle

- Radiotherapy (RT) is applicable across all stages of NSCLC, either as a definitive or palliative treatment.
- All potentially eligible cases should undergo multidisciplinary discussion with radiation oncology input.

2. Definitive RT / SABR

- SABR (stereotactic ablative radiotherapy) / SBRT (stereotactic body radiotherapy): Recommended for patients who are medically inoperable or who refuse surgery. Demonstrated high rates of local tumor control and overall survival (OS).

3. Postoperative setting

- PORT (postoperative radiotherapy): Indicated only for patients with positive surgical margins or with pathologic N2 (pN2) disease after surgery.

4. Locally advanced / node-positive disease

- Concurrent CCRT (concurrent chemoradiotherapy): Standard of care for inoperable Stage II (node-positive) and Stage III patients.
- Sequential CCRT (chemoradiotherapy) or RT alone: Considered for patients with poor performance status or significant comorbidities not fit for concurrent therapy.

5. Metastatic disease

- Oligometastatic RT: Selected Stage IV patients with limited metastatic burden may benefit from local RT after multidisciplinary review.
- Consolidative RT: Stage IV patients showing good response to targeted therapy or immunotherapy may be considered for RT to the primary tumor and/or residual metastatic sites, aiming to improve local control and prolong progression-free survival.

- Brain metastases:
  - WBRT (whole-brain radiotherapy) is commonly used.
  - SRT (stereotactic radiotherapy) / SRS (stereotactic radiosurgery) are options for patients with a limited number of lesions.

6. Palliative indications

- RT is indicated for symptom relief or prevention of complications, including:
  - Pain (e.g., bone metastases)
  - Bleeding (e.g., hemoptysis)
  - Obstruction (e.g., airway or vessel compression)

Simulation and immobilization

- Simulation should be performed using CT scans obtained in the radiotherapy (RT) treatment position with appropriate immobilization devices. Intravenous (IV) contrast, with or without oral contrast, is recommended whenever possible for patients with central tumors or nodal disease to improve target and organ delineation.
- CT-based treatment planning should employ multiple conformal fields. Advanced techniques such as IMRT (intensity-modulated radiotherapy), VMAT (volumetric-modulated arc therapy), TomoTherapy, or Radixact may be utilized to optimize normal tissue sparing, provided that appropriate quality assurance (QA) measures and assessment of tissue interfraction mobility are performed.
- PET/CT improves target definition accuracy, particularly in cases with significant atelectasis or when IV contrast is contraindicated.
- Tumor and organ motion, especially due to respiration, should be evaluated at simulation. Strategies include fluoroscopy, inhale/exhale or slow-scan CT, or ideally, 4D-CT to better characterize motion.

Field design and treatment volume

- Target volumes should be defined for 3D-CRT (three-dimensional conformal radiotherapy), IMRT (intensity-modulated radiotherapy), VMAT (volumetric-modulated arc therapy), TomoTherapy, and Radixact according to standard oncologic and imaging principles.
- GTV (gross tumor volume): the visible or demonstrable extent of disease (primary and nodal) on a single CT phase and/or pathology.

- iGTV (internal gross tumor volume): generated from 4D-CT or motion-inclusive imaging by encompassing the GTV across all respiratory phases, thereby accounting for tumor motion.
- CTV (clinical target volume): includes the iGTV plus regions at risk of microscopic spread.
- PTV (planning target volume): adds a setup margin to the CTV to account for daily positioning error and mechanical variability.

Dose prescriptions

- Definitive RT (radiotherapy): 60–70 Gy in conventional fractions (1.8–2.2 Gy per fraction). A minimum dose of 60 Gy should be delivered.
- Preoperative RT: 45–54 Gy in 1.8–2.2 Gy fractions.
- Postoperative RT (PORT):
  - CTV (clinical target volume) = bronchial stump and high-risk draining lymph node stations.
  - 50–54 Gy in 1.8–2.2 Gy fractions. A boost may be administered to high-risk regions, including areas of nodal extracapsular extension or microscopic positive margins.
- Palliative thoracic RT: A regimen of 30 Gy in 10 fractions is commonly used. Higher-dose or longer-course schedules (e.g., 40–50 Gy in conventional fractions) may be considered in patients with good performance status, as they are associated with modestly improved local control and symptom relief.
- SABR (stereotactic ablative radiotherapy):
  - Regimens with BED (biologically effective dose) ≥100 Gy are associated with significantly better local control and survival compared with lower BED schedules.
  - For peripheral tumors, fractionation of ≥3 fractions is preferred. Regimens with 3–5 fractions may be used, and schedules with >5 fractions are also acceptable depending on tumor location and patient condition.
  - For centrally located tumors (within 2 cm of the proximal bronchial tree or abutting mediastinal pleura) and ultra-central tumors (abutting the proximal bronchial tree), risk-adapted regimens of 4–10 fractions are effective and safe.
  - 54–60 Gy in 3 fractions should be avoided for central or ultra-central tumors due to excess toxicity.

- Whole-brain Radiotherapy (WBRT):

Standard regimens

- 30 Gy in 10 fractions (most commonly used; standard of care for many patients).
- 20 Gy in 5 fractions (often used for poor performance status or limited life expectancy).

Other accepted regimens

- 37.5 Gy in 15 fractions (occasionally used for patients with good prognosis, aiming to reduce late toxicity).
- 40 Gy in 20 fractions (historical regimen, less commonly used now).
- 25 Gy in 10 fractions (shorter-course alternative).
- 8 Gy in 1 fraction (for patients with very poor prognosis or in a purely palliative setting).

Advanced techniques

For patients with a better prognosis (e.g., ≥4 months), hippocampal-sparing WBRT using IMRT, VMAT, TomoTherapy, or Radixact may be considered to reduce cognitive toxicity.

Constraints for organ at risk

- Normal organ dose responses from the QUANTEC project.

Appendix

- Oligometastases: 轉移器官≦3 處且轉移之總病灶≦5 處。
- Oligoprogression: 原發和轉移病灶之惡化部份，器官惡化≦3 處且惡化之病灶≦5 處。

Reference

- NCCN Practice Guidelines in Oncology, 2024
- Perez and Brady's : Principles and Practice of Radiation Oncology, 7th ed, 2018
- Eric K. Hansen, Handbook of Evidence-Based Radiation Oncology