Taipei Veterans General Hospital Practices Guidelines Radiation Oncology

Lung Cancer

Version 2010.1

台北榮總肺癌診療共識

- 關於此臨床指引：肺癌的診療仍在發展階段，本指引主要在呈現目前肺癌診療的進展與共識，醫師應鼓勵病患參與臨床試驗，使其有機會得到最好的治療。在本指引中的化療用藥建議是基於現有的臨床證據，和目前的衛生署或健保局規定無關。

Principles of Radiation Therapy

General Principles

- For resected tumors with pathologic mediastinal nodal involvement (pN2) and negative surgical margins, adjuvant chemotherapy followed by postoperative radiotherapy is preferred, although the sequencing between radiation and chemotherapy in this setting has not been established.

- For tumors with pN2 and positive resection margins, postoperative concurrent chemoradiotherapy is recommended if the patient is medically fit. Radiation therapy should start earlier as local recurrence is the most common failure in this group of patients.

(NCCN NSCLC V.II.2010)

Principles of Radiation Therapy

General Principles

- Conformal radiation therapy ± chemotherapy should be offered to patients with stage I, II, and III NSCLC who are medically inoperable but of reasonable performance status and life expectancy.

- In patients receiving radiation therapy or chemoradiation with curative intent, treatment interruptions or dose reductions for manageable acute toxicities (i.e. Grade 3 esophagitis or hematologic toxicities) should be minimized by conformal treatment planning and aggressive supportive care.

(NCCN NSCLC V.II.2010)

Principles of Radiation Therapy

Radiation Simulation, Planning and Delivery

Treatment planning should be performed by CT scans obtained in the treatment position. IV contrast should be used for better target delineation whenever possible, especially in patients with central tumors or with nodal disease. PET-CT is preferable in cases with significant atelectasis. PET-CT can significantly improve the target accuracy.

(NCCN NSCLC V.II.2010)

Principles of Radiation Therapy

Radiation Simulation, Planning and Delivery

In patients who receive induction chemotherapy, attempts should be made to obtain a baseline planning CT prior to induction chemotherapy. If feasible, the initial radiation fields should cover the pre-chemotherapy tumor volume, and the cone-down fields should cover the post-chemotherapy tumor volume. However, in patients with compromised lung function or large initial tumor volume, the post-chemotherapy volume can be used to avoid excessive pulmonary toxicity.

(NCCN NSCLC V.II.2010)

Principles of Radiation Therapy

Radiation Simulation, Planning and Delivery

In general, photon beam energy between 4 to 10 MV is recommended for beams passing through low density lung tissue before entering the tumor. For large mediastinal tumors or tumors attached to chest wall, 15 MV or 18 MV energies can be considered for more optimal dose arrangement.

In certain situations where there is a large volume of normal lung being irradiated or where tumors are located close to critical structures, intensity modulated radiotherapy (IMRT) may be considered.

(NCCN NSCLC V.II.2010)

Principles of Radiation Therapy

Radiation Simulation, Planning and Delivery

Acceptable methods of accounting for tumor motion, per guideline, include:

1) Motion-encompassing methods such as slow CT scanning, **inhale and exhale breath-hold CT**, four-dimensional (4-D) respiration-correlated CT;
2) Respiratory gating methods using an external respiration signal or using internal fiducial markers;
3) **Breath-hold methods by deep-inspiration breath-hold**, active-breathing control (ABC) device, self breath-hold without respiratory monitoring;
4) Forced shallow breathing with abdominal compression; and
5) Real-time tumor-tracking methods.

(NCCN NSCLC V.II.2010)

Principles of Radiation Therapy

Dose, Volume, and Normal Tissue Constraints for Conventionally Fractionated Radiation Therapy

- Postoperative radiation dose should be based on margin status. Lung tolerance to radiation after surgery is remarkably smaller than those with the presence of both lungs.

- For patients receiving postoperative radiation therapy, more strict DVH parameters should be considered for the lung. The exact limit is unknown for lobectomy cases; mean lung dose should be limited to less than 8.5 Gy in pneumonectomy patients.

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(NCCN NSCLC V.II.2010)

Principle of Target volume delineation

Gross Target Volume (GTV) delineation

- The pulmonary extent of lung tumors should be delineated on pulmonary windows, and the mediastinal extent of tumors should be delineated using mediastinal windows.

- The FDG-PET images can help to categorize suspected mediastinal and hilar adenopathy and differentiate between collapsed lung tissue from tumor. However, false-positive PET scans can be caused by inflammation, and a biopsy is recommended if there is any question

(Image-Guided Radiotherapy of Lung Cancer James D. Cox, Joe Y. Chang, Ritsuko Komaki)

Principle of Target volume delineation

Clinical Target Volume (CTV) delineation

- includes the area of subclinical involvement around the GTV. For the lung parenchymal disease, a margin with **8 mm for adenocarcinoma and 6 mm for squamous cell carcinoma** is required to cover the gross and microscopic disease with 95% accuracy.
- In the absence of radiographic proof of invasion, the CTV of the primary lesion should not extend into the chest wall or mediastinum.
- **8 mm expansions of involved nodes** of the CTV is recommended, but not extend into the major airways or lung, chest wall, or vertebral body without evidence of invasion.

(Image-Guided Radiotherapy of Lung Cancer James D. Cox, Joe Y. Chang, Ritsuko Komaki)

Principle of Target volume delineation

Clinical Target Volume (CTV) delineation

- Regarding CTV of nodal regions, elective nodal irradiation (ENI) remains controversial and should be individualized based on tumor volume, dosimetric parameters of adjacent normal structures, and comorbid conditions. **Involved field radiation to high dose without ENI** has been shown to allow higher dose radiation with acceptable toxicity and low risk of isolated nodal relapse.

- In patients who receive postoperative radiotherapy, CTV should consist of the bronchial stump and high-risk draining lymph node stations.

(Image-Guided Radiotherapy of Lung Cancer James D. Cox, Joe Y. Chang, Ritsuko Komaki)

Principle of Target volume delineation

Planning Target Volume (PTV)

- When patients are immobilized with a Vac-Loc bag or other devices, expansion along all axes of 7 mm is recommended.
- When daily image-guided setup is used, the setup uncertainty can be reduced to 5 mm.
- For patients with tumor motion of < 5mm, simple expansion for the GTV margin is adequate.

(Image-Guided Radiotherapy of Lung Cancer James D. Cox, Joe Y. Chang, Ritsuko Komaki)

- Typically CTV could be expanded 1 cm in all directions (1.5 cm superiorly or inferiorly for tumors of the lower lobe).

Principles of Radiation Therapy (from NCCN v2.2010)

Dose, Volume, and Normal Tissue Constraints for Conventionally Fractionated Radiation Therapy

Table 2. Recommended Doses for Conventionally Fractionated Radiation Therapy

Treatment Type	Total Dose	Fraction Size	Treatment Duration
Preoperative	45-50 Gy	1.8-2 Gy	4-5 weeks
Postoperative			
• Negative margins	50 Gy	1.8-2 Gy	4-5 weeks
• Extracapsular nodal extension or microscopic positive margins	54-60 Gy	1.8-2 Gy	5-6 weeks
• Gross residual tumors	60 to 70 Gy	1.8-2 Gy	6-7 weeks
Definitive			
• Radiation alone or sequential chemoradiation	60-74 Gy	2 Gy	6-7.5 weeks
• Concurrent chemotherapy	60 to 70 Gy	2 Gy	6-7 weeks
Palliative			
• Obstructive disease (SVC syndrome or obstructive pneumonia)	30-45 Gy	3 Gy	2-3 weeks
• Bone metastases with soft tissue mass	30 Gy	3 Gy	2 weeks
• Bone metastases without soft tissue mass	8 Gy	8 Gy	1 day
• Brain metastasis	See CNS Guidelines	See CNS Guidelines	See CNS Guidelines

(NCCN NSCLC V.II.2010)

Principles of Radiation Therapy

Dose, Volume, and Normal Tissue Constraints for Conventionally Fractionated Radiation Therapy

Table 3. Normal Tissue Dose Volume Constraints for Conventionally Fractionated 3DCRT*

Structures	Limits
Spinal Cord	50 Gy in 1.8-2 Gy fractions
Lung	V20 < 37% MLD < 20 Gy
Heart	V40 < 100% V45 < 67% V60 < 33%
Esophagus	Mean dose < 34 Gy
Brachial Plexus	66 Gy in 1.8-2 Gy fractions

*The limits are consistent with those of the ongoing phase III trial RTOG 0617.
Vxx refers to the percentage of whole organ receiving more or equal to xx Gy.
Lung V20 refers to the percentage of both lungs with subtraction of overlapping CTV receiving ≥ 20 Gy, MLD=mean total lung dose.

(NCCN NSCLC V.II.2010)

Principles of Radiation Therapy

Preoperative CCRT

– Candidate for preoperative CCRT
  - Superior sulcus T3, T4
  - Potential respectable disease.
  - Clinical N0 or N1.

–Radiation dose: 45-50 Gy at 1.8-2 Gy per fraction

– Evaluation: the possibility of surgical resection should be evaluated at 4th -5th weeks after CCRT

–Resectable: surgery should be done at the 6th weeks after preoperative CCRT
  - Shift to definitive CCRT when: pneumonectomy is the only way to acquire adequate resection; extensive resection is required for N2 disease,

Principles of Radiation Therapy

Definitive chemoradiotherapy

- Candidate for definitive CCRT
  - inoperable stage IIIA or IIIB with good performance
- Radiation dose: 60-70 Gy or 70-74 Gy at 1.8-2 Gy per fraction

[Note]

Radiation dose may be one significant factor for overall survival in stage I-II after radiation alone or stage III disease treated with concurrent chemoradiation.

When radiation is given concurrently with chemotherapy, a dose up to 74 Gy may be delivered safely, if the dose to normal structures are strictly limited. The role of high dose radiation with concurrent chemotherapy is currently being tested in a phase III randomized trial (RTOG 0617).

Principles of Radiation Therapy

Postoperative chemoradiotherapy

Candidate for postoperative CCRT

- Positive or close margins
- For resected tumors with pathologic mediastinal nodal involvement (pN2) and negative surgical margins, adjuvant chemotherapy followed by postoperative radiotherapy is preferred (the sequencing between radiation and chemotherapy in this setting has not been established.) Individual cases need to be discussed via a multidisciplinary team.

Principles of Radiation Therapy

Small cell lung cancer

Radiotherapy for limited disease:

- Radiotherapy should be delivered as either 1.5 Gy bid to a total dose of 45 Gy (category 1), or 1.8-2.0 Gy once daily to 60-70 Gy.
- Start with chemotherapy cycle 1 or 2 (category 1)
- The radiation target volumes should be defined on the CT scan obtained at the time of radiotherapy planning. However, the pre-chemotherapy CT scan should be reviewed to include the originally involved lymph node regions in the treatment fields.

(NCCN SCLC V.I.2010)

Principles of Radiation Therapy

Small cell lung cancer

Radiotherapy for limited disease:

- Concurrent chemoradiotherapy preferable to sequential therapy in fit patients (category 1)
- Three-dimensional (3D) conformal radiation techniques are preferred, if available.
- PCI dose 25 Gy in 10 fractions or 30 Gy in 10-15 fractions

(NCCN SCLC V.I.2010)

Discussion

Principles of Radiation Therapy

General Principles

- Radiation therapy can be offered as an adjunct for operable patients with resectable diseases, as the primary local treatment for patients with medically inoperable or unresectable diseases, and as an important palliative modality for patients with incurable diseases.

- Radiation therapy can be offered to primary or distant sites as palliative care for stage IV patients with extensive metastasis.

(NCCN NSCLC V.II.2010)

Principles of Radiation Therapy

Dose, Volume, and Normal Tissue Constraints for Conventionally Fractionated Radiation Therapy

- For treatment volume consideration, PTV should be defined per ICRU-62 guidelines, based on GTV, plus CTV margin for microscopic diseases, ITV margins for target motion, and margins for daily set-up errors. GTV should be confined to visible tumors (include both primary and nodal diseases) on CT or PET-CT.

(NCCN NSCLC V.II.2010)

Principles of Radiation Therapy

Radiation Simulation, Planning and Delivery

Significantly lower risk of radiation pneumonitis and improved overall survival have been observed with IMRT compared to 3-D conformal radiation therapy for lung cancer

When IMRT and proton therapy are used, daily image guidance at delivery should be used for quality assurance. The modality of IGRT should be based on the institutional experience and the treatment accuracy.

(NCCN NSCLC V.II.2010)