ASEAN Movement in Radiology

Standard national high-resolution computed tomography (HRCT) Protocol/

A recommendation by The Royal College of Radiologists of Thailand (RCRT) and Thoracic Society of Thailand under Royal Patronage (T.S.T.)

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Diffuse interstitial lung diseases (ILDs) include more than hundreds of diseases which have different causes or underlying, target groups, signs and symptoms, clinical courses, radiographic appearances, treatments, and prognoses. Among them, idiopathic pulmonary fibrosis (IPF) is the most fatal, with prognosis worse than many types of cancer. After decades of no specific treatment, new medications that may help slow down the progression of the fibrosis have been introduced and approved in some countries. Similar to corticosteroid, anti-inflammatory and immunosuppressive drugs which are used to treat some ILDs; these antifibrotic medications could cause certain side effects. In contrast, the cost of treatment is much higher.

To monitor ILDs in terms of incidence, demographic and geographic distributions, and life expectancy; T.S.T. is developing a national ILD database. To ensure that the particular database will provide the most accurate information, diagnosis should be as precise as possible.

However, the diagnoses of most ILDs are multidisciplinary. With the facts that surgical lung biopsies are available in lower than 20% of patients in most

countries[1], HRCT plays an important role in showing disease characters and extension. Certain HRCT patterns are accepted to replace surgical lung biopsies (SLBs) in some diseases.

Unfortunately, typical diagnostic HRCT patterns to replace SLB are not possible in all case, for example, only about half of usual interstitial pneumonia[2]. Initially, a diagnosis could not be made in some cases whose HRCT patterns are not specific and other clinical information is not sufficient. A longitudinal study by following up HRCTs and adding subsequently exhibited clinical data, or even surgical lung biopsy, could eventually establish the diagnosis. These patients need a system that provides a regular clinical and HRCT follow-up as well as the multidisciplinary team to evaluate newly acquired clinical and radiographic information .

Playing a significant role in managing patients with ILDs, standard HRCT is required to ensure that the initial examination will provide sufficient radiographic information where both the initial and follow-up examinations could be compared and the interpretation of all examinations is reproducible, and it could be performed in most institutes.

To develop a typical HRCT protocol; the current situation of interstitial lung diseases in Thailand, the purpose to develop the protocol, and a probable draft of the standard protocol (made by the committee from RCRT) were presented to a panel consisting of thoracic radiologist experts from all parts of Thailand in a meeting held on 11 January 2019 by Foundation of Orphan and Rare Lung Disease (FORLD) and Imaging Academic Outreach Center (iAOC). Knowledge sharing, benefits and disadvantages of the drafted protocol were discussed. Adjustment was done based on feasibility, coverage of all lung diseases, diagnostic accuracy, and radiation safety.

The panel provided a recommended protocol describing scan coverage, technique, collimation, rotation time, pitch, radiation dose, and reconstruction images. The typical protocol recommends a mandatory acquisition for the first HRCT and optional or additional ones for follow-up or particular cases.

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Recommended HRCT Protocol for ILD: Version.1/2019

	Supine/Inspiration (Mandatory in both initial and follow-up)	Supine/Expiration (Mandatory in initial and optional in follow-up)	Prone/inspiration (Optional)
Scan coverage	Whole chest[1]	Whole chest[1]	limited to region of interest[2] (eg. lower chest) or Whole chest[1]
Technique	Volumetric[3]	Recommended: sequential4 (every 10- 20 mm interval) at end expiration Optional: If breath holding is not adequate or tracheobronchomalacia is suspected, volumetric scan during forced expiration is recommended with ultralow radiation dose (*) and highest pitch[7]	Recommended: sequential[4] (every 10-20 mm interval) Optional: If breath holding is not adequate, volumetric scan at the region of interest[2] is recommended with lower radiation dose and highest pitch[7]
Collimation	Thinnest (<1.5 mm)[5]	Thinnest (<1.5 mm)[5]	Thinnest (<1.5 mm)[5]
Rotation time	Shortest (<0.5 s)[6]	Shortest (<0.5 s)[6]	Shortest (<0.5 s)[6]
Pitch	Highest (>1)[7]	-	-
Radiation dose	120 kVp, auto mAs[8] (1-3 mSv)	120 kVp, 20-60 mAs[8] *100 kVp, 40-60 mAs[8] (<1 mSv)	120 kVp, 40-80 mAs[8] (<1 mSv)
Reconstruction[12]	1. Axial, lung-window[9] (high-spatial algorithm) ≤1.5 mm thickness overlap (30-50%)[9] 2. Axial, mediastinal-window[10] (low-spatial algorithm) ≤1.5 mm thickness overlap (30-50%) 3. Coronal[11], mediastinal-window (low-spatial algorithm), ≤1.5 mm thickness contiguous	Axial, lung-window[9] (high-spatial algorithm), ≤1.5 mm thickness	Axial, lung-window[9] (high-spatial algorithm), ≤1.5 mm thickness

Note WL/WW for lung-window setting: -450 to -600 HU/1450 to 1600 HU
WL/WW for mediastinal-window setting: 30 to 50 HU/350 to 450 HU
TBM = tracheobronchomalacia

Appendix

1,3 In order to increase rate of detection of even a small focal lesion, and to reformat multiplanar images for study of vertical distribution
2 In order to decrease radiation dose
4 In female and/or age < 45 year
5 Thinner than 1 mm is possible with increased noise
6,7 In order that the images are motion-free (shortest rotation time and highest pitch result in scan time of the whole chest less than 5 seconds)
8 Automatic exposure control which is available in most CT machines will automatically adjust mA according to the thickness of the region/ Automatic exposure control with indicated maximal dose or fixed low mA could be used in follow up. However, ultralow dose is not recommended in supine inspiratory HRCT
9 For more sharpness
10 In order to demonstrate associated mediastinal or soft tissue findings.
11 In order to study vertical distribution
12 Iterative reconstruction (IR) is recommended to decrease noise

References

1. Lynch DA, Sverzellati N, Travis WD, Brown KK, Colby TV, Galvin JR, et al. Diagnostic criteria for idiopathic pulmonary fibrosis: a Fleischner Society White Paper. Lancet Respir Med 2018; 6:138-53.

2. Cottin V. Lung biopsy in interstitial lung disease: balancing the risk of surgery and diagnostic uncertainty. Eur Respir J 2016; 48:1274-77.