Low Dose High Resolution Lung Computerized Tomography - Modified Technique for Radiation Dose Reduction

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In order to evaluate the best CT technique for diffuse lung diseases with as minimal radiation dose to the patient as possible, and without losing much information on imaging, 60 patients with known diffuse lung disease were divided into 3 groups. Group A was subjected to conventional CT chest protocol, group B subjected to conventional HRCT chest, and group C underwent a limited slice low dose HRCT lung while the radiation dose to the patient was monitored with a dosimeter placed on the skin. Group B patients provided much improved imaging information with considerable reduction in dose as compare to group A. Group B & C patients yielded the comparable imaging information while the patients dose was even more reduced in group C (not much greater than a conventional chest X- ray) without any loss of information.

Key words. Lumg tomputerized tomography, low dose, high resolution

The diagnostic sensitivity and specificity of chest tomography are superior to those of conventional chest X-rays. This will undoubtedly lead to a progressive increase in the use of chest CT. Therefore, steps must be taken to ensure a selected chest technique with excellent images with as little radiation as possible. In order to establish technical recommendations and indication for lung CT, we ran a comparative study on radiation dose, image quality and information provided using different technical protocols.

Material and methods

A total number of 60 patients with known diffuse or generalized lung disease previously diagnosed on X-ray chest or perfusion & ventilation lung scan were selected. Based upon predominant clinical indications they were divided into three batches each consisted of twenty patients for appropriate selection of technique. Films were viewed at lung as well as mediastinal window. We retrospectively compared the diagnostic efficiency of studies performed with three different protocols(Table 1). In group A, with indication given in Table 2, chest CT was performed with 10 mm collimation, scan at 10 mm interval, 120 Kvp, 200 mA and 1.0 sec. In group B, with indication given in table 3, chest CT was performed with 2mm collimations, scan at 10 mm interval, 120 Kvp,200 mA, and 1.0 sec. In group C, same indication given in Table 3, chest CT was performed with 2 mm collimation, scan at 20mm interval, 120 Kvp, 100mA and 1.0 sec.

All the studies were performed on Toshiba X-press Model 1992 Services Hospital Lahore from September 99 to September 2001. Sensors used to measure radiation doses were lithium frouride thermo-luminescent dosimeter attached to patient skin along upper third of sternum.

Results

1. Radiation dose: The average dose in group A with above mentioned parameter was 19.1$\pm$ 1.6 mGy. In group B, with conventional HRCT technique dose was 2.1+ 0.5 mGy. In group C with limited slice technique with half mA the average dose was 0.8+ 0.2 mGy. This compares with a skin dose of 0.1 mGy for posterior-anterior chest radiography.

2. Image Quality evaluation (Table 4) Aeration disturbances, bronchi, fissures and peripheral structures were best seen in examination performed with technique B& C. Thin collimation scan produced grainy mediastinal images which rendered evaluation of mediastinal structures difficult. Reconstruction filter can improve the quality of mediastinal structures in studies performed with HRCT technique. On the whole both LD HRCT (B & C) yielded good quality images the comparative study of whole lung HRCT and limited slice LD HRCT yielded no significant differences in diagnostic information. However, incidence of streak artifacts, particularly in non-cooperative patients examined with lowest mA setting (technique C). On the other hands vessels and mediastinal structures were best seen with the conventional technique (technique A).

Table 1. Technical factors and dose

	Convent/helical	Kv	mA	Sec	Slice thickness	Slice interval	Pitch	Dose inGy
Group A	C	120	200	1	10	10		19.1±1.6
Group B	C	120	200	1	2	10	-	2.1± 0.5
Group C	C	120	100	1	2	20	-	0.8± 0.3

Table 2. Indications for using helical or conventional chest CT technique

Search for metastasis
Search for mediastinal or hilar lymph nodes
Mediastinal studies
Pulmonary masses
Pleural disease
Chest wall disorders
Study of Tuberculosis
Chest trauma

Table 3. Indications for LDHR chest CT technique

Long-standing pulmonary inflammatory processes
Infections in immunocompromised patients
Bronchiectasis , Cystic Fibrosis,
Asthma, Interstitial disease
Bronchopulmonary dysplasia
Bronchiolitis obliterans
Questionable lung disease

Table 4. Image quality evaluation using conventional and LDHR CT techniques

	Artifacts	Aeration Disturb	Bronchi	Vessels	Peripher Structur	Fissures	Mediastinum
Technique A*	+++ +++	+	+ +++ +++	+++ ++ ++	+	+ +++ +++	+++
Technique B#	++	+++			+++		+ +
Technique C^		+++			+++		

+++ = good, ++ = fair, + = poor

* 120 kVp, 200 mA, 1 sec, 10 mm thickness, 10 mm interval, standard filter

120 kVp, 200 mA, 1 sec, 2 mm thickness, 10 mm interval, HR filter

^ 120 kVp, 100 mA, 1 sec, 2 mm thickness, 20 mm interval, HR filter

Discussions

Chest CT examinations have to be tailored to the patient's specific clinical problem. Prior to performing a chest CT all available clinical and radiological information should be reviewed especially recent X-ray chest review is mandatory and rewarding. One should always try to use the CT technique capable of providing the best information with least possible radiation. Thus number of sections and exposure parameters should be decreased as much as possible. This can often be done without loss of information. Direct supervision by the radiologist during chest CT scan can also help to ensure good examinations with the least radiation possible. He can judge and decide whether there is any need for short interspace distance in any particular area of suspected pathology revealed on X-ray chest and can modify the technique accordingly.

Reducing the number of slices to half not only reduces the radiation dose to the patient but also require half space for subsequent X-ray film projection and reducing the film consumption and cost to half.

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