CHAPTER VI

DISCUSSION

6.1. Radiation Dose

The present generation of CT scanners have intrinsically better spatial and contrast resolution and more dose-efficient detectors. They therefore maintain image quality at a lower dose. One possible means of dose reduction is the choice of appropriate tube current time product according to the section thickness. A lower tube current time product can be used together with greater section thickness to obtain signal-to-noise ratio.

For different CT scanners, it has been shown even identical scanning parameters can result in considerable dose differences in patient. This is mainly due to the specific geometry (focus-to-patient and focus-to-detector distance) and filtration characteristics (resulting in beam quality differences) of a scanner.

In order to compare patient doses it is necessary to measure radiation dose for actually applied protocols with various parameters. Knowledge of only the scanning parameters does not allow prediction of locally applied doses for a specific CT system. For this purpose, CTDI or $CTDI_w$ values (calculated per 100 mAs) are needed. CTDI values concerning the radiation dose are regularly published by the manufacturers. In our study, we compared our data with the radiation dose of Sensation 4 and 16 at 100 mAs in operation manual from Siemens company, Germany as show in the table 9.

		Maufacturer		Sensation 4	Sensation 16
		Sensation 4	Sensation 16	Sequential mode	Sequential mode
At 80 kV	Air	13.4 mGy		12.7 mGy	
	Center	7.2 mGy		5.85 mGy	
	Perpheral	8.9 mGy		8.94 mGy	
At 120 kV	Air	29.9 mGy	23.9 mGy	30.89 mGy	26.08 mGy
	Center	19.0 mGy	15.4 mGy	20.77 mGy	17.41 mGy
	Perpheral	21.4 mGy	17.2 mGy	23.76 mGy	19.91 mGy

Table 9 : The differences between our data in Sensation 4 and 16 with manufacturer at 100 mAs.

The radiation doses from our study differs from the values specified by the manufacturer, but not exceed than 10 %. These might resulted from error in conversion, calibration factors, and protocol parameters (i.e. slice collimator, slice thickness). Although, compared to preliminary reference dose values for standard CT examinations proposed in the European Guidelines on Quality Criteria for CT (EC99), Routine head examination $CTDI_w$ is 60 mGy. Our dose for routine head examination in sequence mode, using the Sensation 4 was 60.24 mGy, Sensation 16 was 66.36 mGy. Now, the radiation doses of two MDCT scanners in sequential mode are over the dose limit of EC99. We might be looking for new protocols with the lowest radiation dose compatible with good image quality.

In fact, protocol parameters vary considerably between manufacturers and are often change by operators according to their need. CT operators are urged to be aware of dose considerations when establishing routine protocols so as to maximize the benefit/risk ratio for the patient.

Our study shows that it may be possible to reduce radiation dose by reducing the mAs used during CT scanning without compromising diagnostic image quality. From figure 10 and 11, the radiation dose of high mAs (260 and 320 mAs) very higher than group of low mAs (100, 120 and 150 mAs), graph slope changed to deep slope from lower mAs when using the high mAs. But the graph slope in each group (low mAs and high mAs) was linear correlation. This was the result from the CT scanners changed small target to large target.

6.2. Image Quality

Our assessment of image quality was evaluated of image noise. Noise represents statistical variation of measured density value expressed in Hounsfield units when scanning a homogeneous object such as water. Field size, matrix, reconstruction algorithm, *z*-interpolation and section thickness also effect image noise.

Central noise physically exceeds peripheral noise. The ratio of peripheral to central noise varies for different scanners. Modern scanner specific differences are mainly due to tube voltage and scanner geometry as well as to standard and additional filtration. Some scanner systems provide additional head or body filters, which result in beam shaping and hardening. These filters may be used to reduce the ratio between surface and central dose.

Although applied dose and image noise should be closely correlated theoretically, we found a good to strong correlation between $CTDI_w$ or $CTDI_{vol}$ and image noise for the various protocols evaluated at King Chulalongkorn Memorial Hospital in Bangkok, Thailand.

This could be explain by differences in scanner generation and geometry as well as by differences in protocol parameters. Alteration of kilovoltage and milliamperage represents a different way to reduce radiation exposure. There is a direct relation between image noise and photon flux, dose reduction by lowering kVp and mAs may lead to degradation of image quality. The higher the radiation exposure, the more photons are detected by the CT system, and the lower image noise will be.