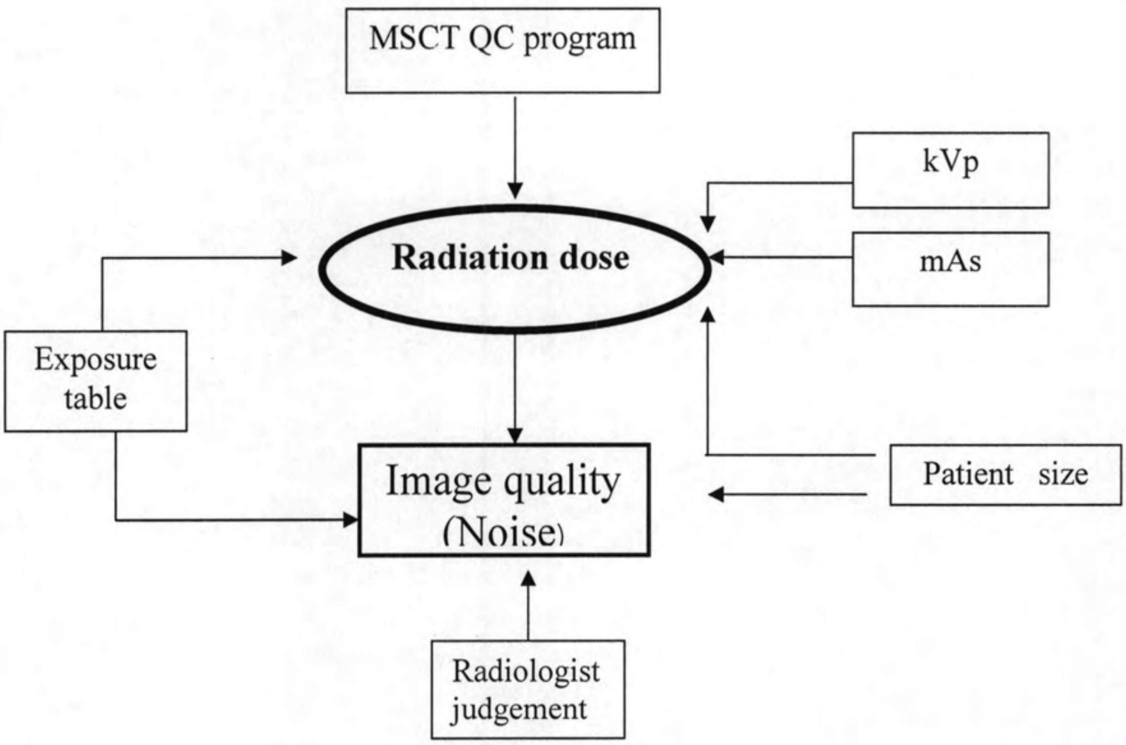
CHAPTER 3

RESEARCH METHODOLOGY

3.1 Research Design

This work has been designed as a descriptive cross-sectional study.

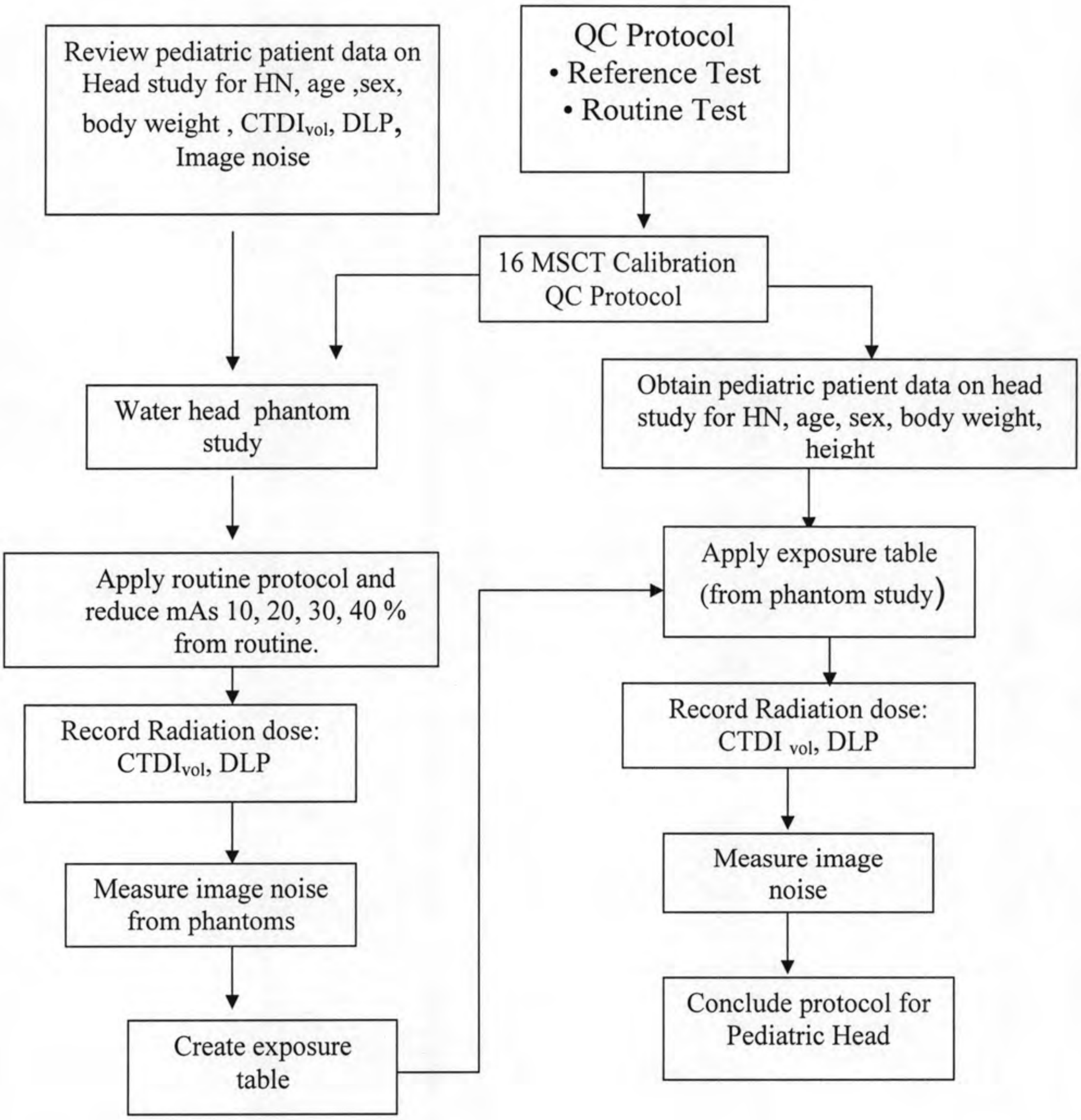
3.1.1 Conceptual framework



3.1.2 Key Word

- Pediatric Radiation Dose
- Multislice Computed Tomography
- Image Quality

3.1.3 Research Design Model



This data collected at Computed Tomography Unit, Chulachakapong Building, 1st floor, Department of Radiology, King Chulalongkorn Memorial Hospital, Bangkok Thailand, by using Sensation 16 –MSCT,(Siemens, Germany).

3.2 Research question

3.2.1 Primary research question

Will the patient dose reduce after using new protocol of reducing mAs in brain examinations according to patient body size ?

3.2.2 Secondary research question

What is the relationship between the patient dose and image noise, and other influencing factors such as body size, kVp, mAs?

3.3 The sample

3.3.1 Target population: All pediatric patients who were requested for brain routine CT examination at King Chulalongkorn Memorial Hospital.

3.3.2 Sample population: In-Out pediatric patients who were requested for brain routine CT examination and had willing to give consent .

3.3.3 Eligible criteria:

3.3.3.1 Inclusion criteria for patient: The patient undergoing one or more of the following examinations

- Brain routine: non contrast material
- The age of patient equal to or less than 12 years old.
- Patients from both sexes.
- The pediatric patients who are scanned by Sensation 16 - MSCT, standard (non spiral or sequence) mode and axial plane.

This patient study was classified into 4 groups of their body weight:

- < 10 Kg
- 11-20 Kg
- 21-30 Kg
- 31- 40 Kg

3.3.3.2 Exclusion criteria

- Patients that used special parameters. (e.g.CTA, 3D study)
- Patients with artifacts that make evaluation impossible.
- Uncooperative patient

3.3.4 Samples Size Estimation:

1 The data is the continuous collection.

2 The sample population is independence, prospective data.

3 31 pediatric patients.(2 groups)

by formula ;

$$n = \frac{Z^2_{(1-\frac{\alpha}{2})}\sigma^2}{d^2}$$

n = Sample size

$Z_{(1-\alpha)}$ = 1.96 (from table $\alpha = 0.05$)

σ^2 = Variance (0.18)

d = Precision (0.15)

Derived; $n = \frac{(1.96)^2 \times (0.180)}{(0.15)^2} = 30.73$

Sample size (n) for 95% confidence interval = 31 examinations per group (2 groups)

3.4 Materials

-Equipment

3.4.1 Siemens Somatom Sensation 16 CT scanner, Computer software unit uses the operating system Windows NT® and the application software *syngo*. The software is used for acquisition and processing.

Figure 3.1; Siemens Sensation 16 CT scanner

- Phantoms :

3.4.2 The manufacturer polymethylmethacrylate (PMMA) cylindrical head phantom of 16 cm diameter and 20 cm water head phantom were used to calibrate the CT scanner as shown in Fig.3.2

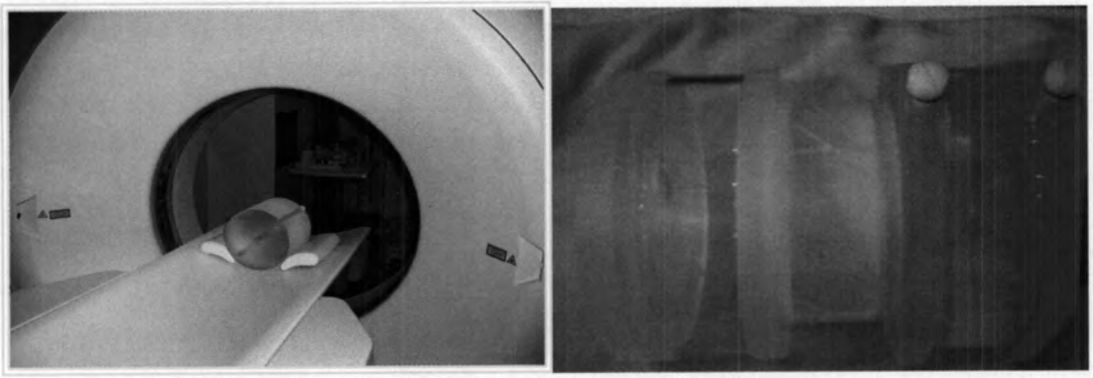


Figure 3.2 ; PMMA phantom 16 cm diameter and 20 diameter cm water phantom

3.4.3 Local made, water cylindrical head phantoms of 9.15, 11.15, 13.15 and 15.8 cm diameter, were used to simulate the pediatric on the investigation of radiation dose and image noise using the clinical routine protocol to establish the exposure table.

- Dosimeters

3.4.4 Electrometer RTI electronic AB type SOLIDOSE 400 electrometer S/N 4103 shown in Fig.3.3

Figure 3.3; Electrometer type SOLIDOSE 400

3.4.5 CT pencil-type ionization chamber is shown in Fig.3.4.It has 4.9 cm^3 active volume, 10 cm total active length.

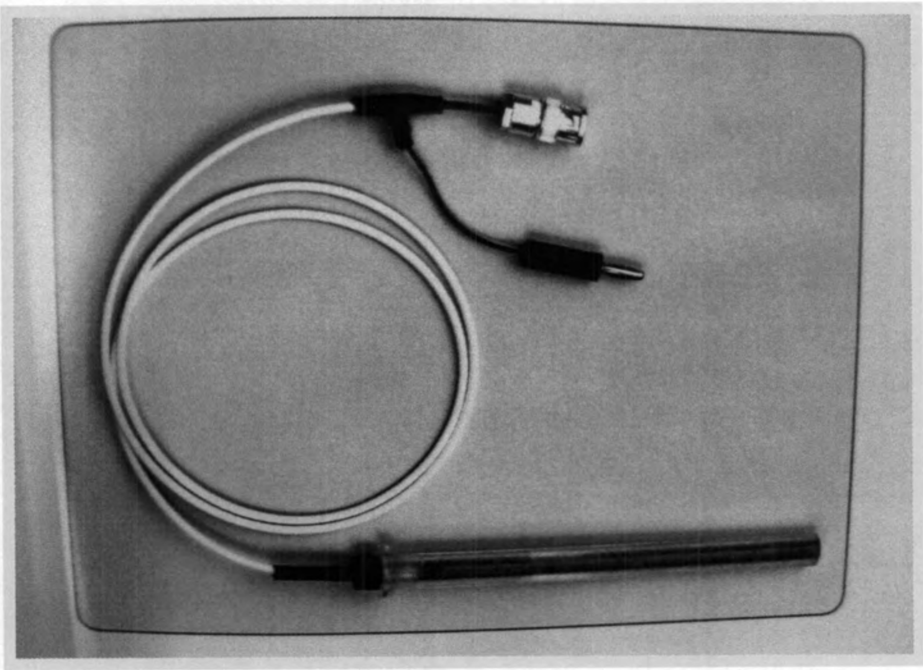


Figure 3.4 ; 10 cm length of the pencil-type ionization chamber

3.4.6 Patient : 62 brain study pediatric patients.

3.5 Methods

The study had been carried out as in the following sequences.

3.5.1 Perform the quality control tests of MSCT scanner.

3.5.2 Reviewing 31 pediatric data collection on brain study: HN, age, sex, body weight(kg), size (AP diameter, cm), height(cm), $CTDI_{vol}$ (mGy), DLP(mGy.cm), image noise (HU), using routine clinical protocol.

3.5.3 Water phantom study

Perform the scan on 9.15cm, 11.15 cm, 13.15 cm and 15.8 cm diameter water phantom for pediatric head to mimic the pediatric brain. Select 10-mm slice thickness acquired at the same location on the phantom using mAs setting ranging from 50, 100, 150, 200 and 300. All other scanning parameters, excluding kVp, were kept constant. A 2-cm^2 circular region of interest (ROI) was then placed over the center of each of these images. The image noise, standard deviations (SD) within the circular ROI was recorded. and correlated with the mAs.

3.5.4 Create an exposure table of patient weight with reduce mAs 10,20,30,40% from routine protocol, perform the scan, record the exposure parameters $CTDI_{vol}$, Dose length product (DLP) and measure image noise.

3.5.5 Apply the protocol of about 20% reduce mAs to the second group of 31 pediatric patients.

3.5.6 Evaluate the image quality by radiologists using the European Commissioning (EC) image quality criteria guideline as shown in Appendix B.

3.5.7 Analyse the 2 groups of pre and post protocol data.

3.5.8 Create practical protocol.

3.6 Statistical and data analysis

3.6.1 Summarization of Data

The radiation dose and noise are continuous data, the average, and range are analyzed to obtain the proper exposure table for pediatric brain study.

3.6.2 Data Presentation

The table, graph and bar chart will be presented .

3.7 Ethical Considerations

This study was performed on routine clinical examination that the intervention will not directly be operated to the patient. However, the ethical approval by the Ethic Committee of Faculty of Medicine, Chulalongkorn University had been determined, the patient information and inform consent had to be processed.

3.8 Limitations

There are limited number of pediatric brain CT examination for early teenage.

3.9 Expected benefits

Pediatric patient dose reduction for brain MSCT examination will be obtained with optimal image quality using new protocol from this study .