On Application Value of ASIR in Low-Dose CT Examination of Cervical Spine for Children

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***Abstract*—Objective: to summarize the application effect of adaptive statistical iterative reconstruction (ASIR) algorithm in low-dose CT examination of cervical spine for children. Method: 78 child patients who received CT examination of cervical spine from February 2017 to June 2018 were chosen for analysis, and they were classified into control group (39 cases) and observation group (39 cases) according to random number table. The control group received filtered back projection (FBP) examination, while ASIR examination was applied for the observation group. Radiation dose and CT scanning image quality of cervical spine were compared. Results: (1) average current, thyroid area current, CT dose index (CTDIvol) and dose length product (DLP) of observation group were obviously lower than that of control group. The differences had statistical significance ($p<0.05$). (2) Noise level of cancellous bone, noise level of neck muscles and subjective scoring of observation group had no statistical significance with the control group ($p>0.05$). Conclusion: the application of ASIR in low-dose CT examination of cervical spine for children contributes to reducing scanning dose of thyroid area and neck, and will not affect image quality, so it deserves to be promoted and applied clinically.**

***Index Terms*—ASIR; child; low-dose CT examination of cervical spine; scanning dose; image quality**

I. Introduction

Low-dose CT examination of cervical spine for children is an important means to detect neck and thyroid diseases, and contributes to confirming lesion type and degree and providing the reference for follow-up treatment [1]. ASIR belongs to a new clinical CT reconstruction algorithm. The current research shows that this technology can keep good image quality, and contribute to reducing children's CT radiation dose, so it is more beneficial to CT scanning diagnosis [2]. Based on this view, the data of 78 child patients who received CT examination of cervical spine from February 2017 to June 2018 were analyzed, and the application effect of ASIR in low-dose CT examination of cervical spine for children was summarized to provide the reference for clinical diagnosis and treatment.

II. Data and Method

A. General Data

78 child patients who received CT examination of cervical spine from February 2017 to June 2018 were chosen for analysis, and they were classified into control group (39 cases) and observation group (39 cases) according to random number table. Control group: 21 male cases, 18 female cases, age 3-12 years old, average age 8.13 ± 1.25; observation group: 23 male cases, 16 female cases, age 3-12 years old, average age 8.13 ± 1.25. Baseline data differences of both groups had no statistical significance ($p<0.05$).

B. Method

ASIR technology was used to carry out cervical spine CT scanning for the observation group with the instrument model of Discovery CT750 provided by American GE. Relevant parameters were adjusted: voltage 120 KVp, Z-axis automatic tube current, 20~200 mA, slice thickness 5.0 mm, pitch 1.375, preset noise 14 HU; image post-reconstruction was completed through 30% ASIR.

FBP examination was used for the control group. The instrument model and relevant parameters were consistent with that of control group. The preset noise index was adjusted as 12 HU.

C. Observation Indicators

(1) Image quality: at CT axial plane image, CT value standard deviation was measured in cancellous bone and neck muscles area of the 6th and the 7th cervical spine for ROI (round or elliptic) to evaluate objective noise value [3].

(2) Average current value of scanning field, CTDIvol, DLP and thyroid area current of both groups were recorded.

(3) Subjective evaluation: 2-3 senior imaging physicians of the department reviewed the scanned images, and "4-score system" was used to score images of CT axial plane. 1 score: the image is coarse; coarseness exists for bone trabecula and cortex of vertebral bone; the layer boundary of subcutaneous soft tissue of the neck is dim. 2 scores: the scanned image has obvious noise; bone cortex of uncovertebral joint and centrum edge is coarse; the layer boundary of subcutaneous soft tissue of the neck is clear. 3 scores: the image is relatively fine and smooth; bone trabecula structure and centrum edge are clear; the layer boundary of subcutaneous soft tissue of the neck is clear. 4 scores: the scanned image is fine and smooth; bone cortex of uncovertebral joint and centrum edge is clear; the layer boundary of subcutaneous soft tissue of the neck is clear. The image ≥3 scores can be used to diagnose the disease [4-5]. The doctors participating in image reviewing did not know the study content.

D. Statistical Method

The data were processed with SPSS21.0 statistical software. $p<0.05$ means the difference has statistical significance. T test was used for "$\bar{x}\pm s$" of measurement data.

III. Results

A. Comparison of Radiation Dose

Average current, thyroid area current, CTDIvol and DLP of observation group were obviously lower than that of control group. The differences had statistical significance ($p<0.05$), as shown in Table 1.

Table 1. Comparison of radiation dose ($\bar{x}\pm s$).

Group	No.	Average current (mA)	Thyroid area current (mA)	CTDIvol (mGy)	DLP (mGy)
Observation group	39	33.46 ± 7.45	35.15 ± 10.10	1.32 ± 0.25	28.79 ± 8.48
Control group	39	42.44 ± 7.32	45.12 ± 11.25	1.87 ± 0.46	41.13 ± 10.52
t	/	5.369	4.118	6.561	5.703
p	/	<0.05	<0.05	<0.05	<0.05

Table 2. Comparison of cervical spine ct image quality ($\bar{x}\pm s$).

Group	No.	Noise level of cancellous bone (mA)	Noise level of neck muscles (mA)	CTDIvol (mGy)
Observation group	39	33.46 ± 7.45	35.15 ± 10.10	1.32 ± 0.25
Control group	39	42.44 ± 7.32	45.12 ±11.25	1.87 ± 0.46
t	/	5.369	4.118	6.561
p	/	<0.05	<0.05	<0.05

B. Comparison of Cervical Spine CT Image Quality

Noise level of cancellous bone, noise level of neck muscles and subjective scoring of observation group had no statistical significance with the control group ($p>0.05$), as shown in Table 2.

IV. Discussion

Low-dose CT examination of cervical spine for children is an important method to discover degenerative disease of cervical spine and cervical spine damage, and has high application value. High-resolution CT examination can clearly show spinal cord form, structure, ligament calcification, intervertebral disc disease and ligamentum flavum hypertrophy as well as form and structure of neck nerve root and spinal cord [6]. Children's body functions are not mature fully, and they have immunologic function limitations. Thus, how to reduce radiation dose in CT scanning is current research hotspot. ASIR is a new CT scanning technology. Hu Qiyun et al. [7] considered that this technology has the advantages of reducing radiation dose of CT scanning and protecting tissues and organs in the scanning field to the largest extent. The result of this study showed that, average current, thyroid area current, CTDIvol and DLP of observation group were obviously lower than that of control group. The differences had statistical significance ($p<0.05$). Iterative algorithm requires relatively small projection quantity in CT scanning, and can generate scanning images under the conditions of small data size and low SNR. Thus, it is an important research content in CT diagnosis field [8]. Overseas studies also indicate that even under the condition of low SNR data, iterative algorithm can achieve complete CT image reconstruction. But, if FBP is used for data reconstruction, the quality of images gained is poor and they images even cannot be used in clinical diagnosis [9-10]. In this study, noise level of cancellous bone, noise level of neck muscles and subjective scoring of observation group had no statistical significance with the control group ($p>0.05$). It thus can be seen that, the application of ASIR technology would not influence scanning image quality, and the image quality of both groups were good. This might be related to moderate low SNR data in CT scanning.

In conclusion, the application of ASIR in low-dose CT examination of cervical spine for children contributes to reducing scanning dose of thyroid area and neck, and will not affect image quality, so it deserves to be promoted and applied clinically.

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