CARE Dose4D CT Automatic Exposure Control System: Physics Principles and Practical Hints

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Introduction to CT Automatic Exposure Control (AEC)

Why use AEC in CT?

The American College of Radiology (ACR) recommends the use of automatic exposure control (AEC) in CT systems. AEC reduces the operator’s exposure to radiation and reduces patient radiation exposure by using information obtained during the CT scan to calculate the tube current that will yield the best image quality for the patient. The procedure is based on the principle of minimizing the radiation dose to patients while achieving the desired image quality.

AEC Basic Principles

AEC is a generic name for any automatic control of tube current density by altering the tube current during the scan to maintain a constant level of radiation exposure to the patient. AEC systems compare the image at the most anterior slice of the patient with the image at the most posterior slice of the patient. This technique is known as image-based modulation. The system also provides constant image noise for all patient sizes.

Table 1: Summary of the most common AEC strategies

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AEC strategies are designed to maintain a constant level of radiation exposure to the patient and provide constant image noise for all patient sizes.

QRM and Tube Capacity:

Quality Reference mAs (QRM) is a technique parameter used by the AEC system to determine the optimal exposure level. It is calculated by dividing the actual tube current–time product (mAs) by the spiral pitch angle. The QRM technique is used to adapt the tube current to different anatomic regions and to varied patient sizes.

Clinical Tips and Tricks

Patients with metallic implants

Radiologists may encounter patients with metallic implants during CT examinations. Metallic implants can limit the use of AEC systems, as they can interfere with the automatic exposure control algorithm. Patients with metallic implants may require manual tube current adjustments to ensure optimal image quality.

Clinical use of CARE Dose4D

CARE Dose4D is an advanced AEC system that provides automatic modulation in the angular and longitudinal directions and adapts to different anatomical regions and patient sizes. CARE Dose4D uses a combination of image-based and user-input modulation strategies to achieve optimal image quality while minimizing radiation exposure.

Topogram

The topogram is a demonstration of the process of CARE Dose4D and the user can control the settings. The topogram shows the estimated tube current for each patient size and anatomical region. The topogram is displayed on the scanner display and can be used to adjust the modulation settings for different patient sizes and anatomical regions.

Quality Reference mAs (QRM)

The QRM is a technique parameter used by CARE Dose4D to determine the optimal exposure level. It is calculated by dividing the actual tube current–time product (mAs) by the spiral pitch angle. The QRM is set equal to the effective mAs that produces an image with the desired noise level. The QRM is set by the operator and can be adjusted for different patient sizes and anatomical regions.

Effective mAs

The effective mAs is a measure of the radiation dose delivered to the patient. It is calculated by multiplying the tube current–time product (mAs) by the spiral pitch angle. The effective mAs is used to compare different CT protocols and to calculate the radiation dose delivered to the patient.

Quality Reference Image

The quality reference image is a demonstration of the CARE Dose4D algorithm and allows the user to adjust the modulation settings. The quality reference image is displayed on the scanner display and can be used to adjust the modulation settings for different patient sizes and anatomical regions.

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