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Evaluating the Impact Exposure Parameters Have on Automatic Tube Current Modulation in a CT Scanner

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Background or Introduction: ATCM reduces dose by adapting tube current to maintain a specified target image quality throughout CT scans and across patients of varying sizes. Scanners modulate current differently: angularly around the patient or along the z-axis; using a reference image or chosen noise/dose reference levels. When misapplied, ATCM can subject patients to excessive radiation doses or produce images of non-diagnostic quality. Thus, evaluating the impact scanner parameters have on radiation dose is vital.

Material and Methods: A 2-step phantom containing an air pocket, to mimic the lungs, was used to conduct a preliminary study(Philips BRILLIANCE iCT Scanner) where parameters were varied to evaluate their impact on tube current. Using the results, a customized phantom—5 diameter steps(16-32cm), a cone, and an air pocket—was built. A comprehensive study on how varying pitch values, tube voltage, and DoseRight index(ATCM setting) impact the TCM for patients represented by this phantom followed.

Results & Discussion: Preliminary Study: changing tube voltage from 120kVp-100kVp increased the tube current—patient radiation exposure—by 38%, and 42% when changed from 120kVp-80kVp. At 120kVP, when the DoseRight Index was changed from 15-20, current values increased by 42%, and from 15-25 this increase was 68%. At 100kVp, when DRI changed from 10-15 the current increased by about 43%, and 10-20 showed a 67% increase. Similarly, at 80kVp, a change of DRI from 10-15 resulted in a 33% increase in tube current. Customized phantom: Data to be collected in September.

Conclusion(s): With ATCM, reducing the tube voltage results in an increase in radiation dose; to compensate for the associated increase in image noise. For multislice CT scanners, pitch value has minimal impact, but DoseRight Index shows a strong positive correlation with tube current. In-depth analysis of how changes to scanner parameters impact patients of varying sizes will be conducted when the study employing the customized phantom is completed.

Keyword(s): Computed Tomography; Automatic Tube Current Modulation; Patient Radiation Dose Optimization