Ultra-High-Resolution Photon-Counting Detector CTA of the Head and Neck: Image Quality Assessment and Vascular Kernel Optimization

头颈部超高分辨率光子计数CTA：图像质量评估和血管重建核优化

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Abstract

摘要

Background: Head and neck CTA requires fine detail evaluation, including characterization of potentially very small vessels and intrastent lumens. Blooming artifacts also hinder evaluation.

背景： 头颈部CTA需要精细的细节评估，包括对潜在的微小血管和支架内腔的特征描述。此外，晕状伪影也阻碍了评估。

Objectives: To evaluate image quality of ultra-high-resolution (UHR) photon-counting detector (PCD) CTA of the head and neck and to explore variation of such quality across reconstruction kernels.

目的： 评估超高分辨率（UHR）光子计数探测器（PCD）头颈部CTA的图像质量，并研究不同重建核对图像质量的影响。

Methods: This prospective study included patients who underwent clinically indicated head and neck CTA from September 2023 to December 2023. Participants underwent PCD CTA in UHR mode. Reconstructions for each examination included a reference reconstruction (reflecting clinical protocols) using 0.8-mm slice thickness and Bv40 kernel, and six UHR reconstructions using 0.2-mm slice thickness and kernels of varying sharpness (Bv48-Bv80). Quantitative measures were recorded. Two radiologists independently evaluated qualitative measures using Likert scales (1=lowest quality; 5=highest quality).

方法： 这项前瞻性研究纳入了2023年9月至2023年12月期间有头颈部CTA临床指征的患者。患者接受了UHR模式的PCD CTA。每次检查的重建包括一个使用0.8毫米的层厚和Bv40核的参考重建（临床标准方案），以及六个使用0.2毫米的层厚和不同锐度的核（Bv48-Bv80）的UHR重建。记录定量测量的结果。两位放射科医生独立使用李克特量表（1=最低质量；5=最高质量）评估定性测量。

Results: The analysis included 103 participants (mean age, 61.3±13.0 years; 56 male, 48 female). Median vessel sharpness (in HU/mm) was 100.9 for reference reconstruction, and for UHR varied from 110.0 for Bv46 to 121.6 for Bv76 and 134.7 for Bv80. Median right internal carotid artery C2 luminal diameter was 3.8 mm for reference reconstruction, and for UHR increased from 4.1 mm for Bv48 to 4.9 mm for Bv80. For both readers, median overall image quality for reference reconstruction was 3, and for UHR was highest for Bv64 (5); calcified plaque blooming artifact for reference reconstruction was 1, and for UHR was highest for Bv72 (5) and Bv76 (5); stent blooming artifact for reference reconstruction was 1, and for UHR was highest for Bv76 (5) and Bv80 (5); soft-plaque delineation for reference reconstruction was 1, and for UHR was highest for Bv76 (5) or Bv80 (5); small-vessel visualization for reference reconstruction was 1, and for UHR was highest for Bv76 (5) or Bv80 (5).

结果： 分析纳入了103名患者（平均年龄61.3±13.0岁；男性56人，女性48人）。参考重建的血管锐度中位数（HU/mm）为100.9，UHR重建的血管锐度中位数为Bv46的110.0、Bv76的121.6和Bv80的134.7。参考重建的右颈内动脉C2腔径中位数为3.8毫米，UHR重建的腔径中位数为Bv48的4.1毫米、Bv80的4.9毫米。对于两位阅片者，参考重建的整体图像质量中位数为3，UHR重建中Bv64最高的图像质量中位数最高，为5；参考重建的钙化斑块晕状伪影为1，UHR重建中，Bv72和Bv76最高，为5；参考重建的支架晕状伪影为1，UHR中，Bv76和Bv80最高，为5；参考重建的软斑块描绘为1，UHR重建中，Bv76或Bv80最高，为5；参考重建的小血管可视化为1，UHR中， Bv76或Bv80最高，为5。

Conclusion: UHR-PCD CTA yielded reduced blooming artifact from calcified plaques or stents, and improved softplaque and small-vessel visualization. These advantages were more pronounced for strongest kernels, although subjective image quality was better for a weaker kernel.
结论：UHR-PCD CTA减少了钙化斑块或支架的光晕伪影，并改善了软斑块和小血管的可视化。这些优势在最强核中更为明显，尽管主观图像质量在较弱核中更好。

Clinical impact: The findings indicate benefits from use of UHR-PCD CTA for head and neck evaluation and may help guide such examinations' kernel selection.
临床影响：这些发现表明UHR-PCD CTA用于头颈部评估的优势，并可能有助于指导此类检查的核选择。