

Brain Perfusion CT: Intra-individual Comparison of Intravascular Time-Attenuation Curves between Examinations

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Quantification and characterization of time-attenuation curves in perfusion computed tomography (PCT) is of high clinical relevance for various pathological conditions such as brain perfusion disorders (e.g. ischemic stroke) or brain tumor characterization and follow-up. As PCT relies on the use of potentially harmful irradiations and iodine contrast agent (ICA) injection, perfusion magnetic resonance imaging (perfusion MRI) is often used instead as a standard of care. Nonetheless, PCT has important advantages such as its ease of use, greater availability, and lower cost. In addition, the linear relationship between the attenuation of the X-ray photons and the ICA's concentration results in more accurate measurements and quantification in comparison to the exponential relationship in MRI. As a research tool in humans, the use of PCT is limited by the radiation exposure. In a research setting, a clinical indication is necessary to justify exposing the patient to radiation. Furthermore, the clinical conditions requiring the use of PCT may increase the variability of the measurements. Thus, the assessment of intra-individual repeatability of time-attenuation curves in PCT may have a tremendous impact on future clinical research.

The aim of the present study is to determine *in vivo* whether quantification of intravascular time-attenuation curves of brain perfusion CT (BPCT) is reliably repeatable when performed on multiple occasions in single individuals under identical conditions.

Twenty-seven patients were included for having undergone at least two BPCT under identical technical conditions over a 2-years period. All relevant technical parameters were identical for all examinations received by any given patient. Intravascular first-pass time-attenuation curves were obtained for the arterial input function (AIF) and the venous output function (VOF). The data processing and statistical analysis were performed using the free integrated development environment RStudio for R. Intraclass correlation coefficients (ICC) were calculated on the following four endpoints derived from the intravascular time-attenuation curves.

The peak attenuation ICC was 0.72 95% CI [0.58, 0.83]. The time to peak ICC was 0.50 95% CI [0.29, 0.67]. The maximum slope ICC was 0.64 95% CI [0.47, 0.77]. The area under the first half of the time-attenuation curve ICC was 0.70 95% CI [0.54, 0.81].

Our results show that BPCT provides repeatable intravascular time-attenuation curves within the same patients with moderate reliability. This somewhat limits the BPCT's further clinical use for quantification but provides useful data for qualitative characterization of hemodynamic profiles. The limited repeatability may be explained mainly by the pathological conditions that the patients suffer when a BPCT is performed. Nonetheless, this pilot study opens promising outlooks for perfusion-based studies and developments.

Jury:

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