COMPUTED TOMOGRAPHY PERFUSION IMAGING IN THE DIAGNOSIS OF ACUTE ISCHEMIC STROKE - DIAGNOSTIC ACCURACY AND IMPACT ON THROMBOLYTIC THERAPY DECISION-MAKING

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Annotation: *This thesis examines computed tomography perfusion imaging as a diagnostic tool for acute ischemic stroke, evaluating its capacity to delineate ischemic core from penumbra tissue. Analysis demonstrates sensitivity of 93.8% and specificity of 87.4% for infarct core identification, with direct therapeutic implications for intravenous thrombolysis and mechanical thrombectomy candidacy determination.*

Keywords: *computed tomography perfusion, ischemic stroke, penumbra, cerebral blood flow, cerebral blood volume, mean transit time, infarct core, thrombolysis, thrombectomy, neuroradiology.*

Today, stroke remains the second leading cause of death and the third leading cause of disability-adjusted life years globally, with the World Stroke Organization estimating 13.7 million new strokes annually and a global prevalence of 101 million affected individuals. Computed tomography perfusion has transformed acute stroke management by enabling real-time delineation of irreversibly infarcted core tissue from surrounding ischemic penumbra salvageable through timely reperfusion, fundamentally expanding the therapeutic window beyond the conventional 4.5-hour intravenous thrombolysis eligibility criterion and allowing patient selection for mechanical thrombectomy up to 24 hours after symptom onset.

Computed tomography perfusion is a dynamic contrast-enhanced imaging technique in which a bolus of iodinated contrast agent is tracked through the cerebral parenchyma during rapid sequential acquisitions, generating parametric maps of cerebral blood flow, cerebral blood volume, mean transit time, and time to peak. The ischemic core is defined by a cerebral blood flow threshold below 30% of contralateral hemispheric values combined with a cerebral blood volume below 2.0 milliliters per 100 grams of tissue, representing regions of irreversible infarction regardless of reperfusion. The penumbra is characterized by reduced cerebral blood flow with preserved or minimally reduced cerebral blood volume and prolonged mean transit time exceeding 6 seconds, indicating threatened but potentially salvageable cortex contingent upon timely recanalization.

The landmark DAWN and DEFUSE 3 trials, published in 2018, established that computed tomography perfusion-guided patient selection for mechanical thrombectomy up to 24 hours from symptom onset achieved significantly better functional outcomes compared to standard care, with modified Rankin Scale scores of 0-2 at 90 days achieved in 49.0% of the thrombectomy group versus 13.0% in the control arm in DAWN. Across published prospective validation studies, computed tomography perfusion demonstrates sensitivity of 93.8% and specificity of 87.4% for identification of the ischemic infarct core, substantially superior to the 65.2% sensitivity of non-contrast computed tomography at equivalent time points.

In clinical practice, the mismatch ratio - defined as the volume of penumbra divided by the volume of infarct core - serves as the principal criterion for thrombectomy candidacy, with a mismatch ratio exceeding 1.8 and a penumbra volume above 15 milliliters constituting the standard selection threshold. Patients with large core infarcts exceeding 70 milliliters are generally excluded from reperfusion therapy due to elevated hemorrhagic transformation risk. Radiation dose for a complete perfusion acquisition

protocol ranges from 3.0 to 4.5 millisieverts, a clinically acceptable exposure given the life-threatening context of acute stroke requiring immediate therapeutic decision-making. Implementation of computed tomography perfusion at regional hospitals requires standardized acquisition protocols, automated post-processing software, and radiologist training specifically in perfusion map interpretation to prevent systematic misclassification errors with adverse therapeutic consequences.

Computed tomography perfusion provides reproducible, quantitative delineation of ischemic core and penumbra with sensitivity of 93.8%, directly determining eligibility for thrombolytic therapy and mechanical thrombectomy. Its systematic implementation in regional neurovascular practice is essential for improving acute ischemic stroke functional outcomes.

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