



Diagnostic accuracy of computed tomography perfusion in patients with acute stroke: A meta-analysis



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ABSTRACT

Purpose: The purpose of this meta-analysis was to evaluate the sensitivity and specificity of computed tomography perfusion (CTP) in diagnosing acute ischemic stroke in patients presenting to the emergency department with stroke-like symptoms.

Methods: Medline, Cochrane, EMBASE, and Google Scholar databases were searched until November 5, 2014 using the following terms: magnetic resonance imaging/MRI, computed tomography/CT, and stroke. Randomized controlled trials, retrospective, and case-controlled studies were included which evaluated patients who presented for emergency assessment of stroke-like systems. Diffusion weighted imaging (DWI) was used as reference standard. Only studies published in English or Chinese were included. Quality assessment and sensitivity analysis were performed to evaluate that strength of the data.

Results: The analysis included six studies with a total of 1429 patients. The pooled overall sensitivity for CTP indicated it had reasonable sensitivity (55.7%) and high specificity (92%). Subgroup analysis indicated that of the different CTP modes, MTT and CBF had higher sensitivities (48.6% and 47.3%, respectively) than CBV (26.3%). CBF and CBV had higher specificity (91.0% and 95.4%, respectively) compared with MTT (86.6%).

Conclusion: All three CTP modes had adequate sensitivity but very high specificity, and among the three CTP modes, CBF had the best diagnostic characteristics.

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1. Introduction

Accurate initial evaluation and management of acute stroke is critical and usually relies upon diagnosis in the emergency room. Currently, there are limitations in the ability to clinically recognize acute ischemic stroke resulting in low rate of thrombolytic treatment [7,8,10]; only about 1–2% of all stroke patients receive acute thrombolytic therapy [3,5,13]. Treatment guidelines recognize that there is limited research and data on how best to detect and treat acute ischemic stroke [1].

Magnetic resonance imaging (MRI), particularly diffusion weighted imaging (DWI) and apparent diffusion coefficient maps, is considered the most reliable imaging test for acute ischemic stroke [4,16]. MRI is in general though to be better than computed tomography (CT) for diagnosing acute stroke [4]. However, adding CT perfusion (CTP) to

non-contrast CT increases the diagnostic accuracy of detecting acute ischemic stroke [14]. Within the first few hours of symptom onset, CTP is at least twice as sensitive as non-contrast-enhanced CT alone [14,17]. It also has the advantage that it is more widely available in the emergency department setting compared to MRI.

A number of studies have evaluated the diagnostic accuracy of CTP for detecting ischemic stroke. The purpose of this meta-analysis was to evaluate the sensitivity and specificity of CTP in detecting acute ischemic stroke.

2. Material and methods

2.1. Search strategy

This meta-analysis was performed in accordance with the PRISMA guidelines. Medline, Cochrane, EMBASE, and Google Scholar databases were searched until November 5, 2014 using the following terms: magnetic resonance imaging/MRI, computed tomography/CT, and stroke. Randomized controlled trials (RCTs), retrospective, and case-controlled studies were included that evaluated patients who presented for emergency assessment of stroke-like systems. Only studies published in English or Chinese were included. Studies with patients who had a history of stroke or brain lesion (eg, brain tumor or trauma etc.) were excluded.

Abbreviations: CTP, computed tomography perfusion; MRI, magnetic resonance imaging; DWI, diffusion weighted imaging; CT, computed tomography; CBV, cerebral blood volume; MTT, mean transit time perfusion.

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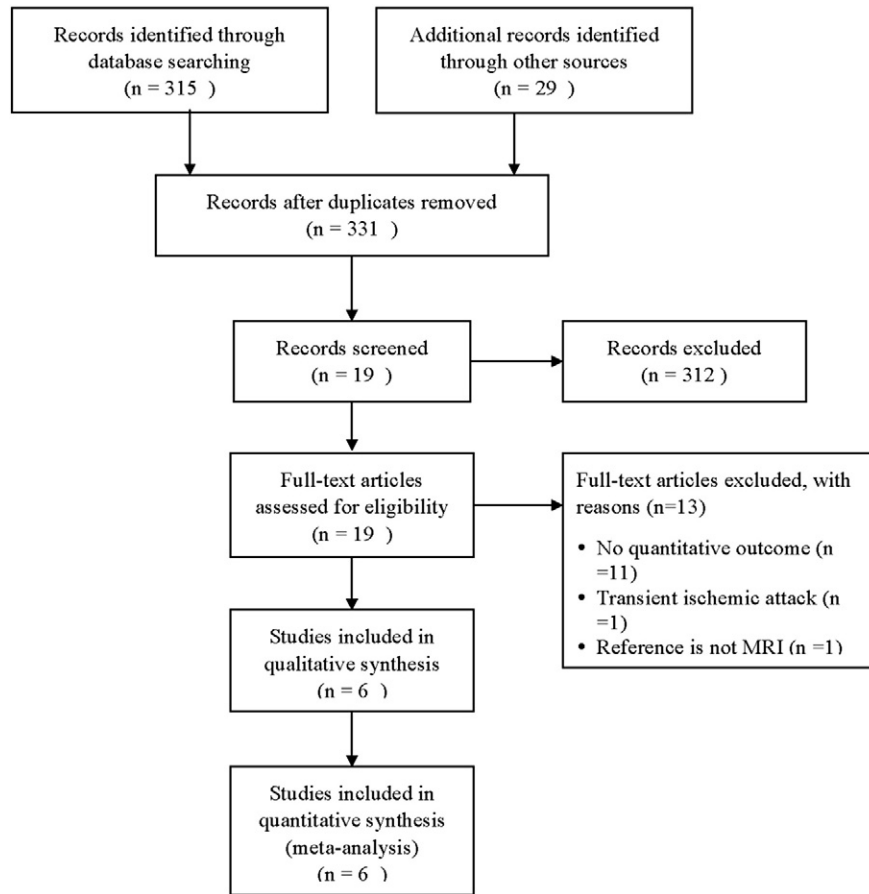


Fig. 1. Flow chart for study selection.

Cohort studies, letters, commentaries, editorials, case reports, proceedings, and personal communication were also excluded. Potential studies were reviewed by two independent reviewers. Where there was uncertainty regarding eligibility, a third reviewer was consulted.

2.2. Data extraction and quality assessment

The following information was extracted from the included studies: the name of the first author, year of publication, study design, number of

participants in each group, participants' age and gender, and the major outcomes.

Quality of the included studies was evaluated using QUADAS [20].

2.3. Statistical analysis

The primary outcome was the sensitivity and specificity of CTP in detecting acute ischemic stroke in patients who presented for emergency assessment of stroke-like symptoms.

Table 1
Summary of basic characteristics of selected studies for meta-analysis.^a

Author, year	Study design	Number of patients	Age (years)	Male (%)	CT scanner used	Time from symptoms onset to CTP (SD)	Reference standard
Hana, 2014	Retrospective	225	NR	69%	64-row	1 h–3 h: n = 19 3 h–6 h: n = 13 6 h–24 h: n = 13 ≥24 h: n = 18 Unknown: n = 24	DWI
Thierfelder, 2014	Retrospective	452	66	53%	128-row	195 min(135)	DWI
Ho, 2013	Retrospective	65	57	37%	64-slice	NR	DWI
Huisa, 2014	Retrospective	165	65	53%	64-channel	Stroke(n = 80): 194 min TIA(n = 34): 152 min Other(n = 51): 166 min	DWI
Lin, 2009	Retrospective	100	67 ^a	NR	16-slice	NR	DWI
Rai, 2008	Retrospective	422	NR	NR	16-slice	35 min	DWI

DWI = diffusion-weighted imaging; NR = not reported.

^a Median age was reported.

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