KAISER PERMANENTE®

Kaiser Foundation Health Plan of Washington

Clinical Review Criteria
Perfusion Computed Tomography (PCT) in Patients with Acute Stroke

Criteria

For Medicare Members

Source	Policy
CMS Coverage Manuals	None
National Coverage Determinations (NCD)	None
Local Coverage Determinations (LCD)	Computed Tomography Cerebral Perfusion Analysis (CTP) (L38700)
Local Coverage Article	Billing and Coding: Computed Tomography Cerebral Perfusion Analysis (CTP) (A58225)

For Non-Medicare Members

Effective until October 1st, 2024

Medical necessity review no longer required.

Effective October 1st, 2024

Retire Policy

If requesting this service, please send the following documentation to support medical necessity:

- Last 6 months of clinical notes from requesting provider &/or specialist

The following information was used in the development of this document and is provided as background only. It is provided for historical purposes and does not necessarily reflect the most current published literature. When significant new articles are published that impact treatment option, Kaiser Permanente will review as needed. This information is not to be used as coverage criteria. Please only refer to the criteria listed above for coverage determinations.

Background

Acute stroke is the third leading cause of death and the third most costly adult disease in the United States. Ischemic stroke is the more common type, and hemorrhagic stroke the more serious. Patients with acute ischemic stroke, who have intracranial arterial obstruction, have poorer prognosis and higher probability of deteriorating at 24 hours. When a cerebral artery is occluded, a core of the brain tissues dies rapidly. Surrounding this infarct core is an area of brain tissue that is hypoperfused but does not die quickly due of collateral blood flow. This area is called the ischemic penumbra, and its fate depends on the rapid reperfusion of the ischemic brain. The presence and extent of the ischemic penumbra is time dependent and may vary among patients. 90-100% of those with supratentorial arterial occlusion show an ischemic penumbra in the first 3 hours of a stroke, but only 75-80% may still have penumbral tissue at 6 hours after a stroke onset. Thus, the rapidity of diagnosis, distinction between types of stroke, and determining the extent and duration of ischemia are all critical in selecting the treatment strategy (Wintermark 2005, Muir 2005, Brunser 2009).

The ischemic penumbra is potentially salvageable with the administration of thrombolytic agents, but irreversibly damaged tissue will not benefit from reperfusion and may be at a higher risk of hemorrhage after thrombolytic therapy. Currently intravenous tissue plasminogen activator (tPA) administered within 3 hours of symptom onset is the only FDA approved drug for acute stroke in North America. Clinical trials showed that it can significantly

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reduce the effects of stroke and reduce permanent disability when administered within a limited time period. Thrombolytic drugs however, can also cause serious bleeding in the brain which could be fatal, and thus it is crucial to determine which patient would likely benefit from or likely to be harmed by the treatment. This narrow time window for using thrombolytic therapy in patients with acute nonhemorrhagic stroke intensified the need for an accurate, rapid, and accessible neuro-imaging technique that is able to identify and quantify ischemic penumbra. MR perfusion, xenon CT, PET and SPECT have been used but are limited by their availability, cost and/or patient tolerance. Clinical assessment scales that predict arterial occlusion have also been developed but are not highly accurate and their use is restricted to the middle cerebral artery (Lev 2001, Hoeffner 2004, Brunser 2009).

Conventional noncontrast CT (NCCT) is the standard initial imaging modality used to evaluate patients with acute stroke symptoms. It is widely available, convenient, and has a high sensitivity for the detection of intracranial hemorrhage which represents an absolute contra-indication to thrombolytic therapy. The Alberta Stroke Program Early Computed Tomography Score (ASPECTS) was developed and validated in 1990 to quantify early ischemic changes on CT scans in the middle cerebral artery territory, before thrombolytic therapy. However, NCCT provides only anatomic and not physiologic information about the vessels. Researchers found that dynamic imaging after rapid injection of contrast material using CT or MRI allows assessing tissue hemodynamics from respective contrast curves, i.e. bolus tracking. MRI is currently the preferred imaging method for determining the core and penumbra tissue. It is the modality used in major clinical trials evaluating the use of tPA for stroke patients. However, MRI scanners may not be available or accessible in some hospitals and rapid imaging of acute stroke patients is of vital importance. CT scanners on the other hand are widely available in emergency rooms, and recent advances in CT and computer technology permit the calculation of contrast curves on a pixel-by-pixel basis providing high resolution perfusion CT (PCT) maps. Perfusion CT imaging has the potential of providing rapid assessment of the structural and functional status of cerebral vessels in patients who would have already undergone unenhanced head CT to exclude acute hemorrhage (Hoeffner 2004, Nabavi 2007).

PCT imaging, using standard nonionic iodinated contrasts can be performed as an adjunct to conventional CT imaging. It adds only a few minutes to the examination and does not require transferring the patient to another imaging device. PCT can be done with any spiral CT scanner and has the advantage of assessing both reversible and irreversible ischemia by generating parametric maps of cerebral blood volume (CBV), cerebral blood flow (CBF), and contrast mean transit time (MTT). The ultimate goal is to discriminate three types of tissues components: 1. The ischemic core that has the most severe ischemia and is the tissue at maximum risk of infarction, 2. Potentially salvageable tissue with mild to moderate ischemia, and 3. Tissue with normal hemodynamics. Unlike conventional CT which is normally assessed visually, perfusion imaging requires quantification of the enhancement in tissues and blood at certain time points following intravenous injection. By demonstrating a regional reduction in perfusion and prolongation of transit time, functional PCT can potentially make a positive diagnosis of acute cerebral ischemia and assess prognosis within the first few hours of stroke onset, when conventional CT images are typically normal. The perfusion maps can be generated in a short time at any workstation equipped by the appropriate software (Hoeffner 2004, Parsons 2005, Miles 2006, Nabavi 2007, Popiela 2008).

PCT however, has limited spatial coverage (20-48 mm thickness) and may not provide information on an ischemia located outside the scanning level. It also cannot detect small lacunae due to its limited spatial resolution. There is considerable variability in the protocols used for PCT scanning, perfusion post procession techniques, and in the threshold between scanners for CBV, CBF, and time to peak enhancement (TTP). Moreover, the reproducibility of PCT postprocessing has not been fully validated, the quantitative accuracy of the results is debated, and the quantitative analysis of the perfusion maps is still evolving, may be time consuming, and is less convenient in an emergency setting. It also has the disadvantage of exposure to ionizing radiation and use of iodinated contrast which may be associated with contrast-induced nephropathy in high risk patients (Wintermark 2005, 2008, Miles 2006, Kohrmann 2007).

The FDA has cleared several software packages (CT perfusion 4, syngo Neuro PBV, syngo perfusion CT and others) for post processing images acquired with CT imaging systems for patients with suspected stroke.

Medical Technology Assessment Committee (MTAC)

Perfusion computed tomography (PCT) for the Treatment of Acute Stroke

08/03/2009: MTAC REVIEW

Evidence Conclusion: Several small studies assessed the accuracy of PCT in identifying the site of occlusion and characterizing the infarct. All had their advantages and limitations; the majority was multicenter, used MRI or

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follow-up MRI, CTA or clinical condition as gold standards, and had blind assessment of results. However, they were mainly retrospective, did not assess the time of recanalization and /or combined the results of those who received and did not receive thrombolytic therapy, all of which are potential sources of bias and confounding.
In a small prospective study, Murphy and colleagues (2006) investigated whether PCT can be used to differentiate between penumbra and infarcted tissue. They used noncontrast CT at 5-7 days as a gold standard and showed that the pair of CBV and CBF derived from PCT had a sensitivity and specificity of 97.0% and 97.2% respectively, in differentiating an infarct from a penumbral tissue. Tan and colleagues 2007, retrospectively compared different CT modalities and found that decreased cerebral blood volume (CBV) derived from PCT was more accurate than CT angiography (CTA) in predicting of the anatomic distribution of final infarct core (sensitivity 80.4%, specificity 96.8%), while CTA was more accurate in determining the site of occlusion (sensitivity 94.6%, specificity 100.00%).
Several other small studies including Schramm et al (2004, N=22, Schaeffer 2008, N=45, and Wintermark 2007, N=42) found that the PCT with or without and CTA correlate highly with MRI results in measuring the lesion volume in patients with acute stroke. In conclusion, the overall published evidence suggests that cerebral blood volume and cerebral blood flow values derived from a baseline PCT may have a potential use in differentiating an infarct from penumbral tissue. However, there are no large randomized trials that examined the use of perfusion CT for selection of patients for thrombolysis. All published randomized controlled trials to date used MRI for the selection of the therapeutic strategy based on the presence or absence of tissues at risk. The use of PCT in acute stroke patients needs to be to be investigated further in large RCTs to determine whether it could be used to guide treatment decisions and improve outcomes.
Articles: The search yielded almost three hundred articles on brain CT in acute stroke patients. Many were review articles, opinion pieces, or dealt with technical aspects of the scan.
The search results were screened for the studies on: 1. Accuracy of PCT in determining the site of vessel occlusion, infarct core, salvageable brain tissue, or collateral flow, and in predicting final infarct volume in patients with suspected acute stroke: The literature search identified around thirty prospective and retrospective studies that evaluated the accuracy of PCT in identifying the site of occlusion and characterizing the infarct. PCT with or without noncontrast CT (NCCT) was compared with MRI, CT angiography, or follow-up NCCT. All studies were small with population sizes ranging from 22 to 44, except for one retrospective study that included 132 patients and evaluated both the accuracy and prognostic value of PCT compared to other CT imaging modalities. The studies presented the results in sensitivity and specificity, or just correlated the findings with those of MRI. Few small studies with sample sizes ranging from 19 to 44 patients, evaluated the accuracy of PCT in predicting prognosis of ischemic stroke. Predicting prognosis was based on comparison with delayed perfusion MRI, follow-up CT, or monitoring the evolution of each patient's clinical condition. The majority of the studies were retrospective, used earlier generations of multiline CT scanners with limited spatial coverage, and no adjustments were made for the potential confounding factors. 2. Impact of PCT in management decisions and patient outcomes: The literature search did not reveal any randomized controlled trials that examined the impact of perfusion CT on the management of ischemic stroke patients and /or clinical outcomes. There was one small case-control study that investigated whether the lesion volume on PCT maps within 3 hours of onset of symptoms would predict final infarct volume, and the effect of intravenous tPA on affected brain tissue. The study however, had several limitations and used the 8-section multidetector scanner. The following three studies on the accuracy of PCT in characterizing the cerebral infarct were selected for critical appraisal: Murphy BD, Fox AJ, Lee DH, et al. Identification of penumbra and infarct in acute ischemic stroke using computed tomography perfusion-derived blood flow and blood volume measurements. Stroke 2006; 37:1771-1777. See Evidence Table. Tan JC, Dillon WP, Liu S, et al. Systematic comparison of perfusion-CT and CT-angiography in acute stroke patients. Ann Neuro. 2007; 61:533-543. See Evidence Table. Shramm P, Schellinger PD, Klotz E, et al. Comparison of perfusion computed tomography and computed tomography angiography source images with perfusion-weighted imaging and diffusion-weighted imaging in patients with acute stroke of less than 6 hours duration. Stroke 2004; 35:1652-1658. See Evidence Table.

The use of Perfusion computed tomography (PCT) for the treatment of acute stroke does not meet the *Kaiser Permanente Medical Technology Assessment Criteria.*

Applicable Codes

Medicare & Non-Medicare-Medical necessity review no longer required

CPT® or HCPC Codes	Description

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0042T	Cerebral perfusion analysis using computed tomography with contrast administration, including post-processing of parametric maps with determination of cerebral blood flow, cerebral blood volume, and mean transit time

***Note:** Codes may not be all-inclusive. Deleted codes and codes not in effect at the time of service may not be covered.

****To verify authorization requirements for a specific code by plan type, please use the **Pre-authorization Code Check**.

Date Created	Date Reviewed	Date Last Revised
09/16/2009	Established annual review because of Medicare criteria 04/05/2011 MDCRPC, 02/07/2012 MDCRPC , 12/04/2012 MDCRPC , 10/01/2013 MPC, 08/05/2014 MPC, 06/02/2015MPC, 04/05/2016MPC, 02/07/2017MPC, 12/05/2017MPC, 10/02/2018MPC, 10/01/2019MPC, 10/06/2020MPC, 10/05/2021MPC , 10/04/2022MPC , 10/03/2023MPC, 05/07/2024MPC	05/07/2024

MDCRPC Medical Director Clinical Review and Policy Committee

MPC Medical Policy Committee

Revision History	Description
05/26/2015	Added CPT code
09/08/2015	Revised LCD L34886 Non-Covered Services.
04/26/2019	Per discussion with Kaiser Permanente neurology and Kaiser Permanente neuro-radiology, this imaging is considered medically necessary in the setting of an acute stroke to determine brain at risk for possible immediate intervention.
09/07/2021	Removed LCD L35008 and LCA A57642 and added LCD L38700 and LCA A58225 under Medicare section.
10/17/2022	Updated Medicare no longer requires review in applicable codes section as this procedure only done in and emergent setting.
05/07/2024	MPC approved to retire clinical criteria as it meets retirement parameters. Requires 60-day notice; effective October 1, 2024.

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