CT Perfusion Imaging of the Brain

Perfusion imaging using CT (computed tomography) provides an assessment of cerebral blood flow that may assist in the identification of ischemic regions of the brain. This technology is proposed as a method to aid treatment decisions in patients being evaluated for acute ischemic stroke, subarachnoid hemorrhage, cerebral vasospasm, brain tumors, and head trauma.

**Stroke.** The goal of acute stroke thrombolytic treatment is to rescue the ischemic penumbra, an area of brain that surrounds the infarct core and is hypoperfused but does not die quickly. Multimodal CT and magnetic resonance imaging (MRI) can be used to assess the cerebral parenchyma, vasculature, and tissue viability in the acute ischemic stroke setting, and are used to detect ischemic tissue, and exclude hemorrhage and other conditions that mimic acute cerebral ischemia.

- Noncontrast CT is used to rule out intracranial hemorrhage, tumor or infection. MR diffusion-weighted imaging (DWI) demonstrates acute infarction, and a gradient-recalled echo (GRE) sequence excludes intracerebral hemorrhage.
- CT angiography (CTA) and MR angiography (MRA) are used to evaluate intra- and extracranial vasculature to detect the vascular occlusion and potentially guide therapy (e.g., intravenous thrombolytics, or intra-arterial or mechanical thrombolysis).

The approved therapy, intravenous tissue plasminogen activator (tPA), requires only a non-contrast CT scan to exclude the presence of hemorrhage (a contraindication to the use of the drug). Current guidelines are to administer (tPA) within the first 3 hours after an ischemic event, preceded by a CT scan. Many patients, however, do not present within the 3-hour window, and thrombolysis carries a risk of intracranial hemorrhage. Thus, more sophisticated imaging may be needed to select the proper use of intra-arterial thrombolysis or mechanical thrombectomy in patients who present more than 3 hours after an ischemic stroke. Perfusion imaging is also being evaluated in the management of other neurological conditions such as subarachnoid hemorrhage and head trauma.

The potential utility of perfusion imaging of acute stroke is described as the following:

- Identification of brain regions with extremely low cerebral blood flow, which represents the core;
- Identification of patients with at-risk brain regions (acutely ischemic but viable penumbra) that may be salvageable with successful intra-arterial thrombolysis beyond the standard 3-hour window;
- Triage of patients with at-risk brain regions to other available therapies, such as induced hypertension or mechanical clot retrieval;
- Decisions regarding intensive monitoring of patients with large abnormally perfused brain regions;
- Biologically-based management of patients who awaken with a stroke for which the precise time of onset is unknown.
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Additional potential uses of perfusion CT in acute stroke may include the following:

- detection and differential diagnosis (e.g., excluding stroke mimics such as transient ischemic attack, complex migraine, seizure, conversion disorders, hypoglycemia, or brain tumors)
- determination of stroke subtype
- determination of stroke extent including additional vascular territories at risk
- identification of patients at high early risk for stroke following transient ischemic attack
- determining the need for blood pressure management
- establishing prognosis

Similar information can be provided by CT and MRI in terms of infarct core and penumbra. However, multimodal CT has a short protocol time (5-6 min), and since it can be performed with any modern CT equipment is more widely available in the emergency setting. CT perfusion is performed by capturing images as an iodinated contrast agent bolus passes through the cerebral circulation and accumulates in the cerebral tissues. (Older perfusion methodologies such as single-photon emission CT [SPECT] and xenon-enhanced CT [XeCT] scanning use a diffusible tracer.) The quantitative perfusion parameters are calculated from density changes for each pixel over time with commercially available deconvolution-based software, where cerebral blood flow (CBF) is equal to regional cerebral blood volume (CBV) divided by mean transit time (MTT). CT angiography/CT perfusion requires ionizing radiation and iodinated contrast. It is estimated that a typical perfusion CT deposits a slightly greater radiation dose than a routine unenhanced head CT (approximately 3.3 mSv). CT perfusion covers limited areas of the brain. Commonly used 16- to 64-slice CT scanners can detect an area of 2- to 4-cm of brain tissue. Whole-brain CT perfusion can be performed with greater than 128-detector row CT.

On October 8, 2009, the U.S. Food and Drug Administration (FDA) issued an Initial Communication about excess radiation during perfusion CT imaging to aid in the diagnosis and treatment of stroke from one facility. Together with state and local health authorities, the FDA has identified at least 250 patients who were exposed to excess radiation during CT perfusion scans. The FDA has received reports of possible excess exposures at facilities in other states, involving more than one manufacturer of CT scanners. The FDA has provided recommendations for facilities and practitioners, and is continuing to work with manufacturers, professional organizations, and state and local public health authorities to investigate the scope and causes of these excess exposures and their potential public health impact. A November 2010 update of this issue is available at http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm185898.htm

Subarachnoid Hemorrhage and Cerebral Vasospasm: Cerebral vasospasm is one of the major causes of morbidity and mortality following aneurysmal subarachnoid hemorrhage (ASAH) in patients who survive the initial hemorrhage and can be seen in about two thirds of patients with ASAH. The typical onset of cerebral vasospasm occurs at 3 to 5 days after hemorrhage, with maximal narrowing on digital subtraction angiography at 5-14 days. Currently, the diagnosis of vasospasm and management decisions rely on clinical examination, transcranial Doppler sonography, and digital subtraction angiography. Although symptomatic vasospasm affects 20% to 30% of patients with ASAH, not all patients with angiographic vasospasm manifest clinical symptoms, and the symptoms can be nonspecific. In addition, patients do not always have both clinical and imaging findings of vasospasm. Due to these limitations, more accurate and reliable methods to detect cerebral vasospasm are being investigated. Two methods being evaluated are CTA and CT perfusion.

Brain Tumors: The current standard for tumor grading is histopathologic assessment of tissue. Limitations of histologic assessment include sampling error due to regional heterogeneity and interobserver variation. These limitations can result in inaccurate classification and grading of gliomas. Since malignant brain tumors are characterized by neovascularity and increased angiogenic activity, perfusion imaging has been proposed as a method to assess tumor grade and prognosis. In addition, perfusion imaging can be repeated and may help to assess the evolution of tumors and the treatment response. Traditionally, perfusion imaging of brain tumors has been performed with MRI, which can estimate tumor blood volume, blood
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flow, and permeability. More recently, CT perfusion has been investigated for glioma grading. Potential advantages, compared with MR perfusion, include the wider availability, faster scanning times, and lower cost. CT perfusion may also be useful in distinguishing recurrent tumor from radiation necrosis.

***Note: This Medical Policy is complex and technical. For questions concerning the technical language and/or specific clinical indications for its use, please consult your physician.

Policy

CT Perfusion Imaging of the brain is considered investigational. BCBSNC does not provide coverage for investigational services or procedures.

Benefits Application

This medical policy relates only to the services or supplies described herein. Please refer to the Member's Benefit Booklet for availability of benefits. Member's benefits may vary according to benefit design; therefore member benefit language should be reviewed before applying the terms of this medical policy.

When CT Perfusion Imaging is covered

Not applicable.

When CT Perfusion Imaging is not covered

CT perfusion imaging of the brain is considered investigational for all indications including the diagnosis and management of acute cerebral ischemia (stroke).

Policy Guidelines

While CT perfusion appears to hold promise for improving care of patients with various neurologic conditions, including the potential individualization of therapy for acute stroke, the current evidence is insufficient to determine whether outcomes are improved with use of this technique. Randomized clinical trials are needed in which a strategy employing CT perfusion in the treatment of acute stroke is compared with traditional strategies. In addition, data on CT perfusion for subarachnoid hemorrhage and brain tumors is limited. Because the impact of CT perfusion imaging on clinical outcomes is not known, this technique is considered investigational.

Billing/Coding/Physician Documentation Information

This policy may apply to the following codes. Inclusion of a code in this section does not guarantee that it will be reimbursed. For further information on reimbursement guidelines, please see Administrative Policies on the Blue Cross Blue Shield of North Carolina web site at www.bcbsnc.com. They are listed in the Category Search on the Medical Policy search page.

Applicable codes: 0042T

BCBSNC may request medical records for determination of medical necessity. When medical records are requested, letters of support and/or explanation are often useful, but are not sufficient documentation unless all specific information needed to make a medical necessity determination is included.
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Scientific Background and Reference Sources


Specialty Matched Consultant Advisory Panel 6/12


Medical Director review 11/2012


Policy Implementation/Update Information

2/16/09 New policy issued. CT perfusion imaging is considered investigational. Notification given 2/16/09. Effective date 5/18/09. (adn)

6/22/10 Policy Number(s) removed (amw)


7/19/11 Routine annual review. No changes. Specialty Matched Consultant Advisory Panel review. Approved as written. (adn)

7/10/12 Descriptions added for subarachnoid hemorrhage/cerebral vasospasm and brain tumors. Policy guidelines updated. Specialty Matched Consultant Advisory Panel review 6/20/12. No change to policy statement. (sk)

11/13/12 Reference added. Description section updated. No change to policy statement. (sk)

7/30/13 Specialty Matched Consultant Advisory Panel review 7/17/13. No change to policy statement. (sk)

10/29/13 Reference added. “of the brain” added to title and policy statement. No change to policy intent. Medical director review. (sk)
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8/12/14  Specialty Matched Consultant Advisory Panel review 7/29/14. No change to policy statement. (sk)

7/28/15  Specialty Matched Consultant Advisory Panel review 6/24/2015. Reference added. No change to policy statement. (lpr)

11/24/15 Reference added. No change to policy statement. (lpr)

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