National Imaging Associates, Inc.*	
Clinical guidelines **CEREBRAL PERFUSION CT**	**Original Date: August 2008**
CPT Codes: 0042T	**Last Revised Date: ~~May~~ February 2021~~0~~**
Guideline Number: NIA_CG_015	**Implementation Date: January 2022~~1~~**

INDICATIONS FOR CEREBRAL PERFUSION CT~~:~~
(ACR, 2017)

In the following settings after initial CT and/or MRI has been performed or when MRI is contraindicated:

- For early detection of acute cerebral ischemia and infarct **to determine the appropriateness of an intervention or procedure** (Guerrero, 2012; Lui, 2010; Menon, 2015; **Simonsen, 2021**; Wintermark, 2013~~; Simonsen, 2021~~).~~)~~
- Differentiating post ictal paralysis **or other stroke mimics** ~~-~~from acute stroke ~~or seizure secondary to stroke~~ after MRI has been completed or is contraindicated **and will guide treatment** (Guerrero, 2012)~~.~~
- For noninvasive evaluation of vasospasm after subarachnoid hemorrhage when transcranial Doppler cannot be done or is indeterminate (Mir, 2014)~~.~~
- Pre-operative evaluation of cerebral blood flow in patients at high risk for developing cerebral hyperperfusion after carotid revascularization (Dapeng, 2016)~~.~~
- For the assessment of cerebral blood flow after carotid ~~-~~revascularization in patients with severe carotid artery stenosis or signs/symptoms of cerebral hyperperfusion (Dapeng, 2016; Vasquez, 2012)~~.~~
- For assessment of cerebrovascular reserve by using acetazolamide challenge in patients with intracranial vascular stenosis who are potential candidates for bypass surgery or neuroendovascular treatment (Galego, 2014; Sorteberg, 2014)~~.~~
- For the assessment of microvascular permeability in patients with intracranial neoplasms (Jain, 2011)~~.~~
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.~~.~~

* National Imaging Associates, Inc. (NIA) is a subsidiary of Magellan Healthcare, Inc.

BACKGROUND~~:~~

Cerebral perfusion computed tomography (CT) or CT perfusion (CTP) is an imaging technique that provides quantitative evaluation of cerebral perfusion by generating maps of cerebral blood flow, cerebral blood volume, and mean transit time after passage of an IV contrast bolus through the region of interest. The technique is not widely used for any indication, especially ~~for~~ in outpatients. It is useful in specific scenarios after initial CT and/or MR~~I~~ imaging has been obtained for assessment, not only of patients with acute stroke, but also a wide range of patients with other cerebrovascular diseases. It ~~may~~ can provide ~~the~~ critical information needed to ~~assess the~~determine the most effective procedure~~s~~ or treatment~~s for the specific conditions~~. In evaluating acute stroke, CTP is usually performed in specialized research centers and is not recommended for screening of these patients in the community setting (Huisa, 2014). It may assist in differentiating the unsalvageable core infarct and salvageable ischemic regions of the brain that may benefit from thrombectomy or thrombolysis (Lui, 2010).

OVERVIEW~~:~~

Acute Cerebral Ischemia (Stroke) – Cerebral perfusion CT can quantitatively distinguish the extent of irreversibly infarcted brain tissue (infarct core) from the severely ischemic but salvageable tissue (penumbra), providing a basis for the selection of acute stroke patients that are most likely to benefit from thrombolytic treatment (ACR, 2016).

Cerebral Ischemia and Infarction and Evaluation of Vasospasm after Subarachnoid Hemorrhage (SAH) – Cerebral perfusion CT measures cerebral blood flow, cerebral blood volume, and mean transit time which can be useful in identifying patients at risk for cerebral ischemia or infarction and for evaluation of vasospasm after subarachnoid hemorrhage. This information may be useful in identifying urgent medical or endovascular treatment. According to the ACR appropriateness criteria, "definitive diagnosis of cerebral vasospasm after SAH is made with catheter angiography. Screening for vasospasm is performed with TCD US [transcranial doppler ultrasound]. CTA or MRA may be useful in the setting of indeterminate TCD" (ACR, 2016). CT or MR perfusion can help differentiate patients with vascular narrowing but normal perfusion due to the presence of collateral circulation from those without adequate collaterals.

Carotid Artery Stent Placement/Revascularization – Cerebral perfusion CT provides a quantitative evaluation of cerebral perfusion and helps in the assessment of the hemodynamic modifications in patients with severe carotid stenosis. Pre-operatively, CTP may help identify patients at high risk of developing hyperperfusion syndrome after carotid revascularization. The syndrome may result in fatal outcomes. Presenting symptoms include "…throbbing frontotemporal or periorbital headache, confusion, macular oedema [sic], visual disturbances, seizures, or focal neurological deficits" (Dapeng, 2016). "The presence of internal carotid artery (ICA) stenosis ≥90% is a main risk factor for the development of HPS. Other important risk factors include severe contralateral ICA disease, poor collateral flow, hypertension, and recent stroke or ischaemia [sic]" (Dapeng, 2016). Post-operatively CTP provides valuable information

for a more thorough assessment in the follow-up of patients after they have undergone carotid revascularization, especially when there is concern for hyperperfusion syndrome (ACR, 2016).

Temporary Balloon Occlusion (BTO) – Balloon occlusion testing is utilized prior to a planned endovascular or surgical procedure that will disrupt blood supply to a part of the brain. Quantitative analysis of cerebral blood flow may be useful in identifying patient who may not tolerate permanent or prolonged occlusion. Due to the significant failure to predict strokes after sacrifice of the carotid artery, there is a vast number of monitoring techniques and protocols during preoperative test occlusion. As CTP monitoring of BTO entails carotid occlusion times ranging from 15-30 minutes and the need to transfer the patient with a catheter in place to the angiography suite, other methods with 60-90 second occlusion times are generally preferred (Galego, 2014; Sorteberg, 2014).

Cerebrovascular Reserve - Cerebral perfusion CT, in conjunction with acetazolamide challenge in patients with intracranial vascular stenosis, can evaluate cerebrovascular reserve capacity and help in estimating the potential risk of stroke. It may help to identify candidates for bypass surgery and endovascular treatment to increase cerebral blood flow.

Intracranial tumors – Cerebral perfusion CT generates permeability measurements in images of brain tumors depicting areas of different blood flow within tumors and the surrounding tissues. This may allow for diagnosis and grading of tumors and may help to monitor treatment.

POLICY HISTORY

Date	Summary
February 2021	• ~~•~~ Updated background information references • Added to determine the appropriateness of an intervention or procedure • Added or other stroke mimics and will guide treatment
May 2020	• Updated background information references • Reordered indications and background information • Changed – "after carotid stent placement" to "after carotid revascularization" in patients with severe carotid artery stenosis and added "or signs/symptoms of cerebral hyperperfusion"
June 2019	• Removed: ○ diagnosis of cerebral ischemia and infarction

	○ **evaluation of patients undergoing temporary balloon occlusion to assess collateral flow and cerebrovascular reserve** • **Added:** ○ **Specified for vasospasm after subarachnoid hemorrhage 'when transcranial Doppler cannot be performed or is indeterminate'** ○ **A f/u study may be needed to evaluate progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason indicating why additional imaging is needed.** • **Updated background information and references**

~~June 2019~~

- ~~Removed:~~
  - ~~diagnosis of cerebral ischemia and infarction~~
  - ~~evaluation of patients undergoing temporary balloon occlusion to assess collateral flow and cerebrovascular reserve~~
- ~~Added:~~
  - ~~Specified for vasospasm after subarachnoid hemorrhage 'when transcranial Doppler cannot be performed or is indeterminate'~~
  - ~~A f/u study may be needed to evaluate progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason indicating why additional imaging is needed.~~
- ~~Updated background information and references~~

~~May 2020~~

- ~~Updated background information references~~
- ~~Reordered indications and background information~~
- ~~Changed – "after carotid stent placement" to "after carotid revascularization" in patients with severe carotid artery stenosis and added "or signs/symptoms of cerebral hyperperfusion"~~

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~~Originally published11 Dec 2020https://doi.org/10.1161/STROKEAHA.120.032020~~
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~~Vasquez RA, Waters MF, Skowlund CJ, et al. Computed tomographic perfusion imaging of non-hemorrhagic cerebral hyperperfusion syndrome and reversal following medical treatment after carotid artery angioplasty and stenting. J Neurointerv Surg. 2012 May; 4(3):e2. doi: 10.1136/jnis.2010.003558. Epub 2011 Jun 16.~~

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Reviewed / Approved by NIA Clinical Guideline Committee

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GENERAL INFORMATIO

It is an expectation that a ; from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.