*National Imaging Associates, Inc.	
Clinical guidelines **CEREBRAL PERFUSION CT**	**Original Date: August 2008**
CPT Codes: 0042T	**Last Revised Date: May 2023**
Guideline Number: NIA_CG_015	**Implementation Date: January 2024**

GENERAL INFORMATION

- *It is an expectation that all patients receive care/services 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.*
- *Where a specific clinical indication is not directly addressed in this guideline, medical necessity determination will be made based on widely accepted standard of care criteria. These criteria are supported by evidence-based or peer-reviewed sources such as medical literature, societal guidelines and state/national recommendations.*

INDICATIONS FOR CEREBRAL PERFUSION CT[1]

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

- Pre-operative evaluation of cerebral blood flow in patients at high risk for developing cerebral hyperperfusion after carotid revascularization[2]
- For assessment of cerebrovascular reserve by using acetazolamide challenge in individuals with intracranial vascular stenosis who are potential candidates for bypass surgery or neuroendovascular treatment[3, 4]
- For the assessment of microvascular permeability in individuals with intracranial neoplasms[5]
- A follow-up study may be needed to help evaluate an individual'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
- In the acute setting:[1]
    - For early detection of acute cerebral ischemia and infarct to determine the appropriateness of an intervention or procedure[6-10]
    - Prediction of hemorrhagic transformation in acute ischemic stroke

- Differentiating post-ictal paralysis or other stroke mimics from acute stroke after MRI has been completed or is contraindicated and will guide treatment[6]
- For noninvasive evaluation of suspected vasospasm related cerebral ischemia/infarction and/or delayed cerebral ischemia after subarachnoid hemorrhage when transcranial Doppler cannot be done or is indeterminate[11]
- For the assessment of cerebral blood flow after carotid revascularization in individuals with severe carotid artery stenosis or signs/symptoms of cerebral hyperperfusion[2, 11]

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 in outpatients. It is useful in specific scenarios after initial CT and/or MR imaging has been obtained for assessment of, not only patients with acute stroke, but also a wide range of patients with other cerebrovascular diseases. It can provide critical information needed to determine the most effective procedure or treatment. 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.[12] It may assist in differentiating the unsalvageable core infarct and salvageable ischemic regions of the brain that may benefit from thrombectomy or thrombolysis.[7]

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.[13]

Cerebral Ischemia and Infarction and Evaluation of Vasospasm after Subarachnoid Hemorrhage (SAH)[14, 15] – 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. Catheter angiography is the gold standard for detecting vasospasm. Screening for vasospasm can be performed with TCD US (transcranial doppler ultrasound) and has high sensitivity and negative predictive value. CTA, CT perfusion or MRA may be useful in the setting of indeterminate TCD. 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.[15]

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".[2] "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*]".[2] 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.[13]

Temporary Balloon Occlusion (TBO) – 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.[3, 4]

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.

REFERENCES

1. American College of Radiology, American Society of Neuroradiology, Society for Pediatric Radiology. ACR-ASNR-SPR practice parameter for the performance of computed tomography (CT) perfusion in neuroradiologic imaging. American College of Radiology. Updated 2022. Accessed February 8, 2023. https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CT-Perfusion.pdf
2. Mo D, Luo G, Wang B, et al. Staged carotid artery angioplasty and stenting for patients with high-grade carotid stenosis with high risk of developing hyperperfusion injury: a retrospective analysis of 44 cases. *Stroke Vasc Neurol*. Dec 2016;1(4):147-153. doi:10.1136/svn-2016-000024
3. Galego O, Nunes C, Morais R, Sargento-Freitas J, Sales F, Machado E. Monitoring balloon test occlusion of the internal carotid artery with transcranial Doppler. A case report and literature review. *Neuroradiol J*. Feb 2014;27(1):115-9. doi:10.15274/nrj-2014-10014
4. Sorteberg A. Balloon occlusion tests and therapeutic vessel occlusions revisited: when, when not, and how. *AJNR Am J Neuroradiol*. May 2014;35(5):862-5. doi:10.3174/ajnr.A3852
5. Jain R. Perfusion CT imaging of brain tumors: an overview. *AJNR Am J Neuroradiol*. Oct 2011;32(9):1570-7. doi:10.3174/ajnr.A2263
6. Guerrero WR, Dababneh H, Eisenschenk S. The role of perfusion CT in identifying stroke mimics in the emergency room: a case of status epilepticus presenting with perfusion CT alterations. *Int J Emerg Med*. 2012;5(1):4-4. doi:10.1186/1865-1380-5-4
7. Lui YW, Tang ER, Allmendinger AM, Spektor V. Evaluation of CT perfusion in the setting of cerebral ischemia: patterns and pitfalls. *AJNR Am J Neuroradiol*. Oct 2010;31(9):1552-63. doi:10.3174/ajnr.A2026
8. Menon BK, Campbell BC, Levi C, Goyal M. Role of imaging in current acute ischemic stroke workflow for endovascular therapy. *Stroke*. Jun 2015;46(6):1453-61. doi:10.1161/strokeaha.115.009160
9. Simonsen CZ, Leslie-Mazwi TM, Thomalla G. Which Imaging Approach Should Be Used for Stroke of Unknown Time of Onset? *Stroke*. Jan 2021;52(1):373-380. doi:10.1161/strokeaha.120.032020
10. Wintermark M, Sanelli PC, Albers GW, et al. Imaging recommendations for acute stroke and transient ischemic attack patients: A joint statement by the American Society of Neuroradiology, the American College of Radiology, and the Society of NeuroInterventional Surgery. *AJNR Am J Neuroradiol*. Nov-Dec 2013;34(11):E117-27. doi:10.3174/ajnr.A3690
11. Vasquez RA, Waters MF, Skowlund CJ, Mocco J, Hoh BL. Computed tomographic perfusion imaging of non-hemorrhagic cerebral hyperperfusion syndrome and reversal following medical treatment after carotid artery angioplasty and stenting. *J Neurointerv Surg*. May 2012;4(3):e2. doi:10.1136/jnis.2010.003558
12. Huisa BN, Neil WP, Schrader R, et al. Clinical use of computed tomographic perfusion for the diagnosis and prediction of lesion growth in acute ischemic stroke. *J Stroke Cerebrovasc Dis*. Jan 2014;23(1):114-22. doi:10.1016/j.jstrokecerebrovasdis.2012.10.020

13. American College of Radiology. ACR Appropriateness Criteria®Cerebrovascular Disease. American College of Radiology (ACR). Updated 2016. Accessed February 8, 2023. https://acsearch.acr.org/docs/69478/Narrative/
14. Salmela MB, Mortazavi S, Jagadeesan BD, et al. ACR appropriateness criteria® cerebrovascular disease. *Journal of the American College of Radiology*. 2017;14(5):S34-S61.
15. American College of Radiology. ACR Appropriateness Criteria® Cerebrovascular Diseases-Aneurysm, Vascular Malformation, and Subarachnoid Hemorrhage. American College of Radiology (ACR). Updated 2021. Accessed February 8, 2023. https://acsearch.acr.org/docs/3149013/Narrative/

POLICY HISTORY

Date	Summary
May 2023	• Updated references • Added - Prediction of hemorrhagic transformation in acute ischemic stroke • General Information moved to beginning of guideline with added statement on clinical indications not addressed in this guideline
May 2022	• Updated background and references • Reorganized indications • Clarified: ○ "For noninvasive evaluation of suspected vasospasm related cerebral ischemia/infarction and/or delayed cerebral ischemia after subarachnoid hemorrhage when transcranial Doppler cannot be done or is indeterminate"

Reviewed / Approved by NIA Clinical Guideline Committee

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