Clinical Guideline

Guideline Number: CG035, Ver. 2

# Transcranial Doppler

**Disclaimer**

*Clinical guidelines are developed and adopted to establish evidence-based clinical criteria for utilization management decisions. Oscar may delegate utilization management decisions of certain services to third-party delegates, who may develop and adopt their own clinical criteria.*

*The clinical guidelines are applicable to all commercial plans. Services are subject to the terms, conditions, limitations of a member's plan contracts, state laws, and federal laws. Please reference the member's plan contracts (e.g., Certificate/Evidence of Coverage, Summary/Schedule of Benefits) or contact Oscar at 855-672-2755 to confirm coverage and benefit conditions.*


**Summary**

Oscar members with conditions affecting blood flow to the brain may be eligible for coverage of Transcranial Doppler (TCD). TCD is a non-invasive technique that can be used to evaluate blood flow in the brain. An ultrasound probe is placed against the head, and sound waves detect blood flow. TCD is most commonly used during surgery that involves the blood vessels that supply the brain to make sure that blood flow is not interrupted during surgery.

TCD is occasionally used outside of surgery to detect some rare forms of abnormal blood flow in the brain. When blood vessels are narrowed, have clots, or have other structural irregularities, TCD can sometimes be used to detect these problems. Only specific blood flow problems in certain parts of the brain can be seen with TCD. Only a licensed physician may order and interpret TCD.

If a single test is being ordered for intracranial pathology in adults, computed tomography (CT), magnetic resonance imaging (MRI), or Computed Tomographic Angiography/Magnetic Resonance Angiogram (CTA/MRA) is the recommended first line test for better results.

In patients aged 2-16 years with sickle cell disease, current expert recommendation calls for annual screenings with TCD.

## Definitions

**"Transcranial Doppler (TCD)"** is a technique that uses ultrasound waves to detect blood flow in the brain's blood vessels.

**"Carotid Endarterectomy"** is a surgical procedure that corrects narrowing of the carotid artery by removing plaque from the inside of the artery to improve blood flow to the brain and reduce strokes.

**"Arteriovenous Malformation"** is an abnormality of blood vessels that occurs when an artery and vein form a connection and become entangled.

**"Stenosis"** is an abnormal narrowing of any structure such as an artery.

**"Carotid Bruits"** are a physical exam finding in which abnormal heart sounds are heard while listening to the carotid arteries with a stethoscope.

## Clinical Indications and Coverage

Note: If a single test is being ordered for intracranial pathology in adults, computed tomography (CT), magnetic resonance imaging (MRI), or Computed Tomographic Angiography/Magnetic Resonance Angiogram (CTA/MRA) is the recommended first line test for better results.

Oscar covers Transcranial Doppler when **ONE** of the following criteria are met:

1. Assessing blood flow and/or emboli during carotid endarterectomy; ***or***
2. Evaluating blood flow in infants meeting any **ONE** of the following criteria:
    a. Screening for intraventricular hemorrhage in infants born at 30 weeks' gestation or less; ***or***
    b. When cerebrovascular evaluation is needed for evaluating blood flow through the circle of Willis or to evaluate for cerebral sinovenous thrombosis in high-risk infants.
3. Detecting stroke risk if patient is aged 2-16 **AND** has sickle cell disease; ***or***
4. Diagnosing non-cardiac right-to-left shunt when the member has **ONE** of the following:
    a. Suspected patent foramen ovale; ***or***
    b. Clinical signs of paradoxical embolism.
5. Evaluating and monitoring for vasospasm after non-traumatic subarachnoid hemorrhage; ***or***
6. Evaluating collateral circulation in patients known to have severe occlusion of intracranial vessels, such as in Moyamoya syndrome; ***or***
7. Diagnosing stenosis of the basal arteries of the brain and the member has **ONE** of the following:
    a. Neurologic signs; ***or***

b. Carotid bruits.

8. Assessing suspected brain death; ***or***
9. Detecting microemboli in cerebral artery embolism; ***or***
10. Diagnosing dissection of vertebral artery.

## Coverage Exclusions

Transcranial Doppler for any other indication is *not covered* by Oscar, as it is considered experimental, investigational, or unproven. Non-covered indications include, but are not limited to, the following:

- Brain tumors
- Diagnosing infectious or inflammatory conditions
- Diagnosing or evaluating cerebral artery emboli, vasoconstriction, or dissection
- Diagnosing or evaluating response to antithrombotic therapy
- Diagnosis or evaluation of cerebral arteriovenous malformations
- Dural arteriovenous fistula
- Epilepsy
- Evaluating cerebral aneurysm
- Evaluating risk of stroke in adults with sickle cell disease
- Evaluating veins
- Following placement or evaluating an intra-cerebral arterial stent
- Idiopathic intracranial hypertension
- Managing trauma
- Migraine headaches
- Neurofibromatosis
- Parkinson's disease or other degenerative conditions
- Predicting outcomes in patients with ischemic infarction (hemorrhagic conversion) or vertebrobasilar stroke
- Psychiatric disorders
- Screening for arterial stenosis in patients with fibromuscular dysplasia
- Screening for carotid stenosis in asymptomatic patients
- Stroke, either ischemic or hemorrhagic
- Traumatic brain injury

### Evidence for Non-Coverage of Above Indications

*Brain tumors*

Ickenstein and colleagues conducted a feasibility study in 2008 evaluating the use of TCD combined with a contrast injection to identify the area of involvement in patients with known glioblastoma.

Although the technique appeared to have some merit in identifying these tumors and their blood flow, the utility of such information remains unknown. There have been no clinical trials to establish TCD's role in usual clinical care of brain tumors.

*Diagnosing or evaluating cerebral artery emboli or dissection*

Per UpToDate clinical guidelines: "Carotid duplex and transcranial Doppler ultrasonography (TCD) may be used to screen for suspected dissection, or to monitor therapy. However, carotid duplex detects abnormalities in only 68 to 95 percent of cases. In addition, duplex and transcranial Doppler have a suboptimal yield for identifying arterial dissection near the skull base and vertebral artery dissection within the transverse foramina. In addition, ultrasound is unreliable for detecting carotid artery dissection in patients with an isolated Horner syndrome. Therefore, confirmation with MRA or CTA should be pursued in ultrasound-negative cases when the clinical history is suggestive of dissection." While TCD may have utility in evaluating and/or diagnosing cerebral artery emboli, thrombosis, or dissection, the clinical value and sensitivity/specificity compared to the current standards of CTA and MRA have not been established.

*Diagnosing infectious or inflammatory conditions*

There are very few case reports of clinicians using TCD in the care of patients with intracranial infectious or inflammatory conditions. Most studies involving TCD involve experimental use of TCD to evaluate systemic processes such as sepsis and their effects on intracranial blood flow rather than for direct patient care. Marquez-Romero and colleagues described an extremely rare case of an aneurysm caused by neurocysticercosis. Cantu and colleagues explored the use of TCD in a more common complication of neurocysticercosis, intracranial arteritis. This 1998 study included 9 patients and did find that TCD provides useful information in this very specific group, but even so its use has been overshadowed by widespread availability of magnetic resonance imaging (MRI) and computed tomography.

*Diagnosis or evaluation of cerebral arteriovenous malformations*

AAN guidelines state that there is "insufficient evidence" to guide the use of TCD in the detection and monitoring of cerebral AVMs. Furthermore, UpToDate guidelines currently recommend MRI, MRA, CT and make no mention of TDU/TCD for the evaluation or workup of these malformations. Further evidence is needed to determine the clinical role of TCD in AVM management.

*Epilepsy*

TCD does not play a role in the usual management of epilepsy. There are few clinical trials that include both epilepsy and TCD, reflecting its uncommon use even in the research setting. One interesting study did compare TCD to the Wada test. The Wada test (anesthetizing one side of the brain during

angiography) is the gold standard for establishing language dominance which becomes an important consideration in patients with refractory disease in presurgical planning. Knake and colleagues compared TCD with the Wada test and found TCD to produce similar outcomes. Importantly, 2 of the 13 patients were unable to be evaluated using TCD due to suboptimal imaging.

*Evaluating response to antithrombotic therapy*

TCD is sometimes used in the research setting to evaluate the effectiveness of antithrombotic therapy following acute ischemic stroke. Its role in clinical practice is yet to be determined. Saqqur and colleagues used TCD as part of a multifaceted program to predict which patients would do poorly after antithrombotic therapy to help stratify patients who may be candidates for interventional therapy. While this approach does appear promising, improved outcomes with this method have yet to be demonstrated. The American Academy of Neurology agreed in its clinical guidelines that TCD probably does provide information in evaluating patients after antithrombotic therapy, but it also stated that the clinical utility of this information remained unclear.

The most exciting use of TCD in recent years has centered on treatment of stroke in combination with antithrombotic therapy. Early studies indicated that use of ultrasound waves may help to expose more of the thrombus to the antithrombotic medication. While some waves were found to be too strong and lead to hemorrhage, milder ultrasound waves appear safe. However, the large multicenter trial evaluating this technique, the CLOTBUST-ER trial, was terminated early after enrolling 675 of the planned 800 patients due to futility of treatment.

*Evaluating veins*

While evaluation of the arterial system with TCD is common and established, evaluation of venous pathology is much less common. A 2008 review by Stoltz found that the false negative rate was unacceptably high when using TCD to evaluate cerebral venous thrombosis. Other imaging modalities are more commonly accepted for this application.

*Managing trauma*

There have been numerous studies citing the potential of TCD to improve clinical outcomes in traumatic brain injury (TBI). This potential has largely been explored in response to TBI becoming the defining injury in recent wars in Iraq and Afghanistan for United States service members. Amyot and colleagues wrote a 2016 review describing the effectiveness of different neuroimaging techniques and found TCD to be useful, especially in the military setting in which access to other less portable modalities is limited.

Use of TCD in the civilian setting in the management of TBI has been described, but clinical outcome studies are lacking. The American Academy of Neurology guidelines note that TCD probably does provide some useful information in evaluating traumatic vasospasm but that its clinical utility remains to be determined. The review by Amyot and colleagues noted that because TCD has the potential to identify vasospasm prior to the development of neurologic deficits, it may offer clinicians a window of time to intervene and prevent neurologic deterioration. While this potential seems clearly worth exploring, to date there are no studies that have demonstrated prevention of stroke or improvement in other outcomes with the use of TCD following TBI. TCD may also be useful in evaluating intracranial pressure following TBI, but it is unlikely to supplant direct pressure monitoring as the gold standard.

*Migraine headaches*

Because migraines are a vasomotor disorder, TCD provides real-time visualization of one of the underlying processes leading to this type of headaches. TCD has been used in the research setting to evaluate patient response to therapy such as triptan medications, beta blockers and acupuncture. Outside of the experimental setting, though, evidence for its use is lacking.

A 2017 systematic review by Shayestagul and colleagues found that there were no changes in blood flow velocity in the middle cerebral artery during migraine attacks. The data hinted that perhaps there was a decrease in blood flow velocity early on in the attacks, and the authors suggested that future studies should focus on this early phase of migraine attacks when researching TCD and migraine headaches.

*Neurofibromatosis*

Neurofibromatosis is a hereditary syndrome that is sometimes associated with vasculopathy. A 2013 retrospective analysis by Ghosh and colleagues looking at 312 patients, 15 (4.8%) had evidence of vasculopathy. In this series of patients, magnetic resonance angiography (MRA), the gold standard, was used to evaluate intracranial disturbances in blood flow.

TCD's role in this condition is much less defined. Paschoal and colleagues used TCD to screen patients with Neurofibromatosis for cerebral vascular disease prior to performing MRA. Three of the four patients with abnormal TCDs were confirmed to have disease on confirmatory testing with MRA, resulting in a positive predictive value of only 75%. And because MRA was not done on the patients with a normal TCD, negative predictive value and sensitivity, the numbers typically used to help select a screening test, can not be calculated.

*Parkinson's disease*

Numerous articles describe efforts to use TCD as an aid in diagnosing Parkinson's disease. Changes to a part of the brainstem, the substantia nigra, are a hallmark of the disease, and some operators of TCD are able to detect these changes in some patients. Pilotto and colleagues performed a 2015 review of TCD for this purpose and found that while it does provide some useful information, it requires a patient with appropriate bony anatomy to allow the probe to visualize the correct structures as well as sufficient operator experience. A 2011 review by Walter found that the clinical relevance of changes to the substantia nigra via TCD may be overstated. Overall, there may be some utility in using TCD to aid in the diagnosis of Parkinson's disease, but its role has not been fully established. UpToDate clinical recommendations for diagnosis of PD using TCD state that "further research is necessary to establish the utility and diagnostic accuracy of this technique"

*Psychiatric disorders*

The use of TCD in the evaluation or management of psychiatric disorders is experimental and is not a routine use of the technique. Mijajlovic and colleagues in a 2014 review describe a potential research avenue using TCD to evaluate the brainstem for the diagnosis and monitoring of patients with unipolar depression. And Schupbach and colleagues performed a 2007 trial evaluating cerebral blood flow changes in patients with schizophrenia. But application of TCD for psychiatric disorders remains rare even in experimental settings, and it currently does not play a clinical role in the diagnosis or management of psychiatric disorders.

## Applicable Billing Codes (HCPCS/CPT Codes)

| **CPT/HCPCS Codes covered if criteria are met:** | |
|---|---|
| *Code* | *Description* |
| 93886 | Transcranial Doppler study of the intracranial arteries; complete study |
| 93888 | Transcranial Doppler study of the intracranial arteries; limited study |
| 93890 | Transcranial Doppler study of the intracranial arteries; vasoreactivity study |
| 93892 | Transcranial Doppler study of the intracranial arteries; emboli detection without intravenous microbubble injection |
| 93893 | Transcranial Doppler study of the intracranial arteries; emboli detection with intravenous microbubble injection |

| **ICD-10 codes covered if criteria are met:** | |
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| D57-D57.819 | Sickle Cell Disease |
| G45.0 | Vertebro-basilar artery syndrome |
| G93.82 | Brain death |
| I60.01-I60.02 | Nontraumatic subarachnoid hemorrhage -carotid siphon and bifurcation |
| I60.11-I60.12 | Nontraumatic subarachnoid hemorrhage-middle cerebral artery |
| I60.2 | Nontraumatic subarachnoid hemorrhage from anterior communicating artery |
| I60.31-I60.32 | Nontraumatic subarachnoid hemorrhage from posterior communicating artery |
| I60.4 | Nontraumatic subarachnoid hemorrhage from basilar artery |
| I60.51-I60.52 | Nontraumatic subarachnoid hemorrhage from vertebral artery |
| I60.6 | Nontraumatic subarachnoid hemorrhage from other intracranial arteries |
| I60.8 | Other nontraumatic subarachnoid hemorrhage |
| I63.00 | Cerebral infarction due to thrombosis of unspecified precerebral artery |
| I63.011-I63.012 | Cerebral infarction due to thrombosis of vertebral artery |
| I63.02 | Cerebral infarction due to thrombosis of basilar artery |
| I63.031-I63.032 | Cerebral infarction due to thrombosis of carotid artery |
| I63.09 | Cerebral infarction due to thrombosis of other precerebral artery |
| I63.10 | Cerebral infarction due to embolism of unspecified precerebral artery |
| I63.111-63.112 | Cerebral infarction due to embolism of vertebral artery |
| I63.12 | Cerebral infarction due to embolism of basilar artery |
| I63.131-I63.132 | Cerebral infarction due to embolism of carotid artery |
| I63.19 | Cerebral infarction due to embolism of other precerebral artery |
| I63.20 | Cerebral infarction due to unspecified occlusion or stenosis of unspecified precerebral arteries |
| I63.211-I63.212 | Cerebral infarction due to unspecified occlusion or stenosis of vertebral arteries |

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| I63.231-I63.232 | Cerebral infarction due to unspecified occlusion or stenosis of carotid arteries |
| I63.29 | Cerebral infarction due to unspecified occlusion or stenosis of other precerebral arteries |
| I63.311-I63.312 | Cerebral infarction due to thrombosis of middle cerebral artery |
| I63.321-I63.322 | Cerebral infarction due to thrombosis of anterior cerebral artery |
| I63.331-I63.332 | Cerebral infarction due to thrombosis of posterior cerebral artery |
| I63.341-I63.342 | Cerebral infarction due to thrombosis of cerebellar artery |
| I63.39 | Cerebral infarction due to thrombosis of other cerebral artery |
| I63.411-I63.412 | Cerebral infarction due to embolism of middle cerebral artery |
| I63.421-I63.422 | Cerebral infarction due to embolism of anterior cerebral artery |
| I63.431-I63.432 | Cerebral infarction due to embolism of posterior cerebral artery |
| I63.441-I63.442 | Cerebral infarction due to embolism of cerebellar artery |
| I63.511-I63.512 | Cerebral infarction due to unspecified occlusion or stenosis of middle cerebral artery |
| I63.521-I63.522 | Cerebral infarction due to unspecified occlusion or stenosis of anterior cerebral artery |
| I63.531-I63.532 | Cerebral infarction due to unspecified occlusion or stenosis of posterior cerebral artery |
| I63.541-I63.542 | Cerebral infarction due to unspecified occlusion or stenosis of cerebellar artery |
| I63.59 | Cerebral infarction due to unspecified occlusion or stenosis of other cerebral artery |
| I63.6 | Cerebral infarction due to cerebral venous thrombosis, nonpyogenic |
| I63.8 | Other cerebral infarction |
| I65.01 - I65.03 | Occlusion and stenosis of right vertebral artery - Occlusion and stenosis of bilateral vertebral arteries |
| I65.1 | Occlusion and stenosis of basilar artery |
| I65.21 - I65.23 | Occlusion and stenosis of right carotid artery - Occlusion and stenosis of bilateral carotid arteries |

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| I65.8 | Occlusion and stenosis of other precerebral arteries |
| I65.9 | Occlusion and stenosis of unspecified precerebral artery |
| I66.01 - I66.03 | Occlusion and stenosis of right middle cerebral artery - Occlusion and stenosis of bilateral middle cerebral arteries |
| I66.11 - I66.13 | Occlusion and stenosis of right anterior cerebral artery - Occlusion and stenosis of bilateral anterior cerebral arteries |
| I66.21 - I66.23 | Occlusion and stenosis of right posterior cerebral artery - Occlusion and stenosis of bilateral posterior cerebral arteries |
| I66.3 | Occlusion and stenosis of cerebellar arteries |
| I66.8 | Occlusion and stenosis of other cerebral arteries |
| R09.89 | Arterial Bruit |
| Z48.812 | Encounter for surgical aftercare following surgery on the circulatory system |
| **ICD-10 codes not covered:** | |
| C71.0 - C71.9 | Malignant neoplasm of brain |
| C79.31 - C79.49 | Secondary malignant neoplasm of brain and nervous system [spinal cord] |
| D33.0 - D33.2 | Benign neoplasm of brain |
| D43.0 - D43.4 | Neoplasm of uncertain behavior of brain and spinal cord |
| D49.6 | Neoplasm of unspecified behavior of brain |
| E75.00 - E75.19 E75.23, E75.25 E75.29, E75.4 | Disorders of sphingolipid metabolism and other lipid storage disorders |
| F01.50 - F99 | Mental and behavioral disorders |
| F84.2 | Rett's syndrome |
| G00.0 - G09 | Inflammatory diseases of the central nervous system |
| G10 - G12.9, G13.8 | Systemic atrophies primarily affecting the central nervous system |
| G20 - G26 | Extrapyramidal and movement disorders |
| G30.0 - G32.8 | Other degenerative diseases of the nervous system |

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| G40.00 - G40.919 | Epilepsy and recurrent seizures |
| G43.001 - G43.919 | Migraine |
| G80.3 | Athetoid cerebral palsy |
| G90.01 - G91.9 | Other disorders of the nervous system |
| G93.7 | Reye's syndrome |
| G93.89 - G93.9, G94 | Other and unspecified disorders of the brain |
| G95.0 - G95.9 | Other and unspecified diseases of spinal cord |
| G99.0 - G99.8 | Other disorders of nervous system in diseases classified elsewhere |
| I63.30 - I63.39, I66.01 - I66.9 | Cerebral thrombosis |
| I72.0 - I72.9 | Other aneurysm |
| I77.3 | Arterial fibromuscular dysplasia |
| Q85.00 - Q85.9 | Neurofibromatosis (nonmalignant) [in children] |
| R56.1 | Post traumatic seizures |
| R56.9 | Unspecified convulsions |
| S02.0xx+ - S02.42x+, S02.600+ - S02.92x+ | Fracture of skull and facial bones [traumatic brain injury] |
| S04.011+ - S04.899+ | Injury of cranial nerve [traumatic brain injury] |
| S06.0x0+ - S06.9x9+ | Intracranial injury [traumatic brain injury] |
| Z13.6 | Encounter for screening for cardiovascular disorders [screening for carotid artery stenosis in asymptomatic persons] |
| Z79.01 | Long-term (current) use of anticoagulants |
| Z79.02 | Long-term (current) use of antiplatelets/antithrombotics |

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## Clinical Guideline Revision / History Information

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