

Cigna Medical Coverage Policy



**Subject Transcranial Doppler (TCD)
Ultrasonography**

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[Computed Tomography Angiography \(CTA\)
and Magnetic Resonance Angiography
\(MRA\)](#)

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Coverage Policy

Cigna covers Transcranial Doppler (TCD) ultrasonography (Current Procedural Terminology® [CPT] code 93886, 93888) as medically necessary for ANY of the following indications:

- screening of children age 2–16 years with sickle cell disease for assessing stroke risk
- detection and monitoring of angiographic vasospasm (VSP) after nontraumatic (spontaneous) subarachnoid hemorrhage (SaH)
- detection of abnormal cerebral blood flow and/or embolic events during carotid endarterectomy (CEA) as well as in the immediate postoperative period

Cigna does not cover TCD ultrasonography (CPT 93886, 93888, 93890, 93892, 93893) for ANY other indication because it is considered experimental, investigational or unproven.

General Background

Transcranial Doppler (TCD) ultrasonography is a noninvasive real-time measurement of blood flow characteristics and cerebrovascular hemodynamics within the basal arteries of the brain. TCD can be administered with a hand-held transducer or by continuous bedside monitoring using standard head frames. During TCD, inaudible sound waves are transmitted through the tissues of the skull. These sound waves reflect off blood cells moving within the blood vessels, allowing the radiologist to calculate their speed. The sound waves are recorded and displayed on a computer screen. TCD is a complex physiological test requiring in-depth skill training and understanding of cerebrovascular anatomy, physiology, and a variety of clinically diverse pathological conditions. TCD is used in the hospital or office-based setting (Alexandrov, et al., 2012; Purkayastha, et al., 2012).

TCD ultrasonography should not be confused with echoencephalography which is a type of diagnostic ultrasound that can be used on neonates for determination of ventricular size, delineation of cerebral contents, and detection of fluid masses or other intracranial abnormalities.

TCD is used principally in the evaluation and management of patients with diverse forms of cerebrovascular disease. Conventional or digital subtraction angiography (DSA) are considered to be the reference standard test(s) for evaluating vascular patency and degree of stenosis in intracranial vessels. Direct comparisons of TCD with techniques that image the intracranial circulation [conventional angiography, DSA, computerized tomographic angiography (CTA), and magnetic resonance angiography (MRA)] are variable depending upon the indication and the diagnostic criteria used for correlation purposes in specific disease states. All non-invasive techniques are less than 100% sensitive and specific when compared to conventional angiography. Even where comparative data are available from particular centers, concerns regarding the ability to generalize results, which may be due to operator-dependent factors (which apply to all five techniques) and comparability of relevant pathology in the tested populations, would limit inferring from published reports how these techniques would perform in settings other than those in which they were directly tested.

The main advantages of the non-invasive techniques over conventional or DSA are that they are often faster to perform, are not associated with the morbidity and rare mortality of conventional angiography. However, contrast (with its attendant risks) is used with CTA. For certain clinical settings or types of correlations, the most appropriate gold standard may be computed tomographic (CT) scan, magnetic resonance imaging (MRI), diffusion-weighted MRI (DWI), perfusion-weighted MRI (PWI), transesophageal echocardiography, single photon emission computed tomography, positron emission tomography, electroencephalography (EEG), hemodynamic measurements (such as stump pressure), experimental models, pathology, neuropsychological tests or clinical outcomes, such as transient ischemic attack, stroke, mortality, disabling stroke, or hemorrhagic complications. It is recommended that the reference standard against which TCD should be evaluated should be selected according to the clinical setting. It has been recommended that when more than one technique may provide clinically relevant information, clinical judgment (including issues of local access, risk, availability and competence) should guide the choice of the appropriate technique or combination of techniques in particular situations (Sloan, et al., 2004).

A chief limitation of TCD is that it can demonstrate cerebral blood flow velocities only in a limited portion of large intracranial vessels, although large vessel intracranial arterial disease commonly occurs at these locations. In general, TCD is most useful when the clinical question pertains to those vessel segments. However, in some settings, TCD can detect indirect effects, such as abnormal waveform characteristics suggestive of proximal hemodynamic or distal obstructive lesions, which may be clinically informative. The aforementioned limitation also applies to MRA and CTA, depending upon the areas imaged, the algorithms used, and the diligence of the technologist. In addition, DSA and conventional angiography may be inconclusive if all relevant vessels or vessel portions are not imaged, if a critical imaging view is omitted, or if image quality is suboptimal (Sloan, et al., 2004).

Factors that may affect TCD results include (Chernecky, et al., 2008):

- the body habitus of the patient and the technical condition of the equipment
- flow velocity is age-dependent and decreases continuously through adulthood
- detection of small aneurysms is limited by insonation angles and spatial resolution
- intramural calcification may inhibit sound penetration, leading to false-positive results
- accurate transmission and reflection of ultrasonographic signals can be affected by the presence of calcium or gas overlying the vessel
- intracranial pressure, blood pressure and volume, hematocrit, and subarachnoid hemorrhage affect flow velocity
- tobacco and caffeine use

With TCD, false-negative exams of vasospasm are associated with chronic high blood pressure, increased intracranial pressure, severe spasm of the carotid siphon, and distal vasospasm. False-positive and false-negative results have been reported when evaluating for cross flow through the anterior and posterior communicating arteries in patients with occlusive cerebrovascular disease (Chernecky, et al., 2008).

There are many proposed applications for TCD including, but not limited to, the following (Chernecky, et al., 2008; American Academy of Neurology [AAN], 2004):

- predict the risk of stroke in children with sickle cell anemia
- vasoconstriction as a result of insult
- cerebral dynamics after head injury
- intraoperatively to monitor velocity in the middle portion of the cerebral artery during carotid endarterectomy (CEA)
- evaluate collateral circulation stenosis
- establish brain death in adults
- diagnostic in intracranial aneurysms, arteriovenous malformations, and moyamoya syndrome
- assessment of blood supply in intracranial neoplasms
- cerebral microembolism detection, for the detection of cerebral microembolic signals in a variety of cardiovascular/cerebrovascular disorders/procedures
- coronary artery bypass graft (CABG) surgery, during CABG for detection of cerebral microemboli and to document changes in flow velocities and carbon dioxide (CO₂) reactivity during CABG surgery
- vasomotor reactivity (VMR) testing (i.e., vasoreactive study), for the detection of impaired cerebral hemodynamics in patients with severe (>70%) asymptomatic extracranial ICA stenosis, symptomatic or asymptomatic extracranial ICA occlusion, and cerebral small-artery disease

U.S. Food and Drug Administration (FDA)

The FDA regulates TCD systems as Class II devices, and the commonly used systems have been approved via the FDA 510(k) process (FDA, 2013).

Literature Review

Transcranial Doppler (TCD) ultrasonography is a broadly used noninvasive diagnostic procedure. Professional society recommendations have been published in an effort to guide appropriate use of this imaging modality for selected patient indications. Settings in which TCD ultrasonography is able to provide information and in which its clinical utility is established include screening of children age 2–16 years with sickle-cell disease for assessing stroke risk and for detection; monitoring of angiographic VSP after nontraumatic (spontaneous) subarachnoid hemorrhage (SaH); Additionally, there is evidence in peer-reviewed published studies and textbook literature that TCD is an accepted method for monitoring cerebral blood flow to detect embolic events during and after CEA (Ogasawara, et al., 2005; AAN, 2004; Ackerstaff, et al., 2000).

Although TCD may be able to provide some information, the diagnostic utility of TCD compared to that of other established diagnostic tools remains to be determined or has not been established for numerous indications and applications as outlined below.

Professional Societies/Organizations

American Society of Neuroimaging: The American Society of Neuroimaging Practice Guidelines Committee, international neurosonological organizations, and experts in TCD have developed a practice standard for TCD which is the first part of a series of practice standards for TCD. The authors report that “scanning protocols, number of vessels, depth ranges for routine evaluation as well as reporting of TCD examination vary between institutions. Given the emphasis on accreditation of vascular laboratories, there is a need for standardization of scanning and interpretation processes.” Subsequent parts of the series will detail specific TCD procedures, diagnostic criteria for interpretation of abnormal studies as well as competency standards for neurovascular sonographers and interpreting physicians (Alexandrov, et al., 2007).

The second part of the practice standards for TCD outlines the clinical indications and expected outcomes for TCD in routine clinical practice (Alexandrov, et al., 2012). The multidisciplinary panel of experts reviewed the published literature on TCD from 1982 through December 2009 in their respective fields, including previous updates and considered reported clinical indications as established if TCD performance has been tested in terms of applicability, yield, accuracy, and prognosis including outcomes (broadly defined as proven diagnostic value in a specific clinical situation, therapeutic implications of test results, identification of high-risk patients, detection of periprocedural complication mechanism, i.e., when information derived from TCD impacted clinical decision making and the choice of management options). For evaluating the quality of evidence and strength of

recommendations for the specific clinical indications the panel used the “Format for an Assessment” developed by the American Academy of Neurology:

Class I Evidence provided by one or more well-designed, randomized controlled clinical trial

Class II Evidence provided by one or more well-designed, clinical studies (eg, case control, cohort studies)

Class III Evidence provided by one or more expert opinions, nonrandomized historic controls, or case reports

Strength of Recommendation

Type A Strong positive recommendation, based on class I evidence or overwhelming class II evidence when circumstances preclude randomized clinical trials

Type B Positive recommendation, based on class II evidence

Type C Positive recommendation, based on strong consensus of class III evidence

Type D Negative recommendation, based on inconclusive or conflicting class II evidence

Type E Negative recommendation, based on evidence of ineffectiveness or lack of efficacy, based on class II or class I evidence

Specific established clinical indications for TCD in routine clinical practice that met the author’s criteria include: sickle cell disease, cerebral ischemia (stroke, transient ischemic attack; TIA), carotid artery stenosis and occlusions, vasospasm after subarachnoid hemorrhage (SAH), brain death, and periprocedural or surgical monitoring.

The following are established clinical indications as outlined in the guideline along with the quality of evidence and strength of recommendation ratings:

Sickle Cell Disease:

“TCD can identify children with the highest risk of first-ever stroke and those in need of blood transfusion [Quality of evidence: class I; Strength of recommendation: type A].”

Subarachnoid Hemorrhage:

“Numerous studies have shown the effectiveness of TCD in diagnosing cerebral vasospasm both in anterior and posterior circulation following SAH [Quality of evidence: class II; Strength of recommendation: type B].”

Cerebral Ischemia

- **Acute Cerebral Ischemia:** “With over 1,700 papers published as of December 2009, this subject is one of the most studied among TCD applications. An indication “ischemic stroke” or “transient ischemic attack” may necessitate not only a complete diagnostic examination in order to detect the presence of stenooclusive disease [Quality of evidence: class II; Strength of recommendation: type B].”
- **Intracranial Arterial Disease (ICAD):** “TCD provides important information and may serve a screening tool for the detection of ICAD [Quality of evidence: class II; Strength of recommendation: type B].”
- **Vasomotor Reactivity:** “In addition to vessel surveillance, TCD testing can include assessment of vasomotor reactivity [Quality of evidence: class II; Strength of recommendation: type B].”
- **Cerebral Embolization:** “Patients with ischemic strokes, TIAs, or asymptomatic high grade ICA stenosis can also undergo TCD monitoring for emboli to detect, localize, and quantify cerebral embolization [Quality of evidence: class II; Strength of recommendation: type B].”
- **Detection of RLS:** “Patients with ischemic stroke and TIAs thought to be due to paradoxical embolism can undergo TCD “bubble” test to detect RLS in patients [Quality of evidence: class II; Strength of recommendation: type B].”

Cerebral Circulatory Arrest: “The efficacy of TCD for the detection of cerebral circulatory arrest for confirmation of a clinical diagnosis of brain death has been documented by various independent investigators [Quality of evidence: class II; Strength of recommendation: type B].”

Clinical Indications for TCD Monitoring

"TCD offers noninvasive real-time monitoring at bedside using standard head frames with no complications reported from these procedures that can be extended up to several hours, if necessary. Continuous monitoring can be deployed in several clinical situations such as:

- emboli detection in patients with symptomatic or asymptomatic extracranial or intracranial carotid artery disease [Quality of evidence: class II; Strength of recommendation: type B].
- monitoring thrombolytic therapy to increase the chance of tissue plasminogen activator (t-PA)-induced recanalization, to detect reocclusion, or persisting occlusion with no recanalization [Quality of evidence: class II; Strength of recommendation: type B].
- perioperative monitoring during stenting, carotid endarterectomy, and cardiovascular surgery (CABG) to detect embolism, thrombosis, hypo and hyperperfusion as the main causes of perioperative strokes [Quality of evidence: class III; Strength of recommendation: type C].
- functional TCD monitoring including vasomotor-reactivity and specific task testing [Quality of evidence: class III; Strength of recommendation: type D]."

American Academy of Neurology (AAN): The Therapeutics and Technology Assessment Subcommittee of the AAN Assessment: Transcranial Doppler Ultrasonography reviewed the sensitivity and specificity of TCD and transcranial color-coded sonography (TCCS) for various disease states (AAN, 2004; Sloan, et al., 2004). This technology assessment was reaffirmed in 2007 and is current as of June 2010. The major recommendations of the AAN's technology assessment of TCD ultrasonography are listed below:

- Settings in which TCD ultrasonography is able to provide information and in which its clinical utility is established:
 - Screening of children age 2–16 years with sickle-cell disease for assessing stroke risk. The sensitivity is 86% and specificity 91%. The reference standard is conventional angiography.
 - Detection and monitoring of angiographic VSP spontaneous subarachnoid hemorrhage (sSaH). The sensitivity and specificity varies based on each intracerebral artery. The-reference standard is conventional angiography.
- Settings in which TCD is able to provide information, but in which its clinical utility, compared with other diagnostic tools, remains to be determined:
 - Intracranial steno-occlusive disease: TCD is probably useful for the evaluation of occlusive lesions of intracranial arteries in the basal cisterns, especially the ICA siphon and middle cerebral artery. Data are insufficient to recommend replacement of conventional angiography with TCD. The sensitivity and specificity varies based on intracerebral artery. The reference standard is conventional angiography.
 - Cerebral circulatory arrest (adjunctive test in the determination of brain death): If needed, TCD can be used as a confirmatory test, in support of a clinical diagnosis of brain death. The reference standard is conventional angiography, EEG and clinical outcome.
- Settings in which TCD is able to provide information, but in which its clinical utility remains to be determined:
 - Cerebral thrombolysis: TCD is probably useful for monitoring thrombolysis of acute middle cerebral artery occlusions. The reference standard is conventional angiography, MRA and clinical outcome.
 - Cerebral microembolism detection: TCD monitoring is probably useful for the detection of cerebral microembolic signals in a variety of cardiovascular/cerebrovascular disorders/procedures. Data do not support the use of this TCD technique for diagnosis or monitoring response to antithrombotic therapy in ischemic cerebrovascular disease. The reference standard is experimental model, pathology, MRI and neuropsychological testing.
 - CEA: TCD monitoring is probably useful to detect hemodynamic and embolic events that may result in perioperative stroke during and after CEA in settings where monitoring is felt to be necessary. The reference standard is EEG, MRI or clinical outcomes.
 - Coronary artery bypass surgery (CABG) surgery: TCD monitoring is probably useful during CABG for detection of cerebral microemboli. TCD is possibly useful to document changes in flow velocities and carbon dioxide (CO₂) reactivity during CABG surgery. Data are insufficient regarding the clinical

impact of this information. Data are presently insufficient regarding the clinical utility of this information, particularly in patients at various levels of predicted risk for stroke or encephalopathy. No reference standard is noted.

- VMR testing: TCD is probably useful for the detection of impaired cerebral hemodynamics in patients with severe (>70%), asymptomatic extracranial ICA stenosis; symptomatic or asymptomatic extracranial ICA occlusion; and cerebral small-artery disease. How the results from these techniques should be used to influence therapy and affect patient outcomes remains to be determined.
 - VSP after traumatic subarachnoid hemorrhage (tSAH): TCD is probably useful for the detection of VSP following tSAH, but data are needed to show its accuracy and clinical impact in this setting.
 - TCCS: TCCS is possibly useful for the evaluation and monitoring of space-occupying ischemic middle cerebral artery infarctions. More data are needed to show it has value versus CT and MRI scanning and if its use affects clinical outcomes.
- Settings in which TCD is able to provide information, but in which other diagnostic tests are typically preferable:
 - Right-to-left cardiac shunts: Whereas TCD is useful for detection of right-to-left cardiac and extracardiac shunts, TEE is superior, as it can provide direct information regarding the anatomical site and nature of the shunt.
 - Extracranial ICA stenosis: TCD is possibly useful for the evaluation of severe extracranial ICA stenosis or occlusion but, in general, carotid duplex and MRA are the diagnostic tests of choice.
 - Contrast-enhanced TCCS: Contrast-enhanced TCCS may provide information in patients with ischemic cerebrovascular disease and aneurysmal subarachnoid hemorrhage (aSAH). Its clinical utility versus CT scanning, conventional angiography, or non-imaging TCD is unclear.

The current practice parameter on neuroimaging of the neonate by the AAN states routine screening cranial ultrasonography should be performed on all infants < 30 weeks' gestation once between 7–14 days of age and should be optimally repeated between 36–40 weeks' postmenstrual age. This strategy detects lesions such as intraventricular hemorrhage, periventricular leukomalacia, and low-pressure ventriculomegaly. Currently ultrasound, CT, and MRI represent the major imaging modalities for evaluation of critically ill infants (Ment, et al., 2002). It appears that these recommendations have not been updated since 2002. According to the guideline developer, this guideline has been reviewed and is still considered to be current as of October 2005.

In the updated evidence-based guideline for determining brain death in adults (Wijdicks, et al., 2010), the quality standards subcommittee of the AAN discusses the methods of ancillary testing for the determination of brain death stating that, "in clinical practice, electroencephalogram (EEG), cerebral angiography, nuclear scan, TCD, computed tomography angiography (CTA), and magnetic resonance imaging (MRI)/magnetic resonance angiography (MRA) are currently used ancillary tests in adults. Most hospitals will have the logistics in place to perform and interpret an EEG, nuclear scan, or cerebral angiogram, and these three tests may be considered the preferred tests. Ancillary tests can be used when uncertainty exists about the reliability of parts of the neurologic examination or when the apnea test cannot be performed. In some protocols, ancillary tests are used to shorten the duration of the observation period. The interpretation of each of these tests requires expertise. In adults, ancillary tests are not needed for the clinical diagnosis of brain death and cannot replace a neurologic examination. Physicians ordering ancillary tests should appreciate the disparities between tests and the potential for false-positives (i.e., the test suggests brain death, but the patient does not meet clinical criteria). Rather than ordering ancillary tests, physicians may decide not to proceed with the declaration of brain death if clinical findings are unreliable". For TCD the authors report that:

- TCD is useful only if a reliable signal is found. The abnormalities should include either reverberating flow or small systolic peaks in early systole. A finding of a complete absence of flow may not be reliable owing to inadequate transtemporal windows for insonation. There should be bilateral insonation and anterior and posterior insonation. The probe should be placed at the temporal bone, above the zygomatic arch and the vertebrobasilar arteries, through the suboccipital transcranial window.
- Insonation through the orbital window can be considered to obtain a reliable signal. TCD may be less reliable in patients with a prior craniotomy.

American Heart Association (AHA)/American Stroke Association (ASA): The AHA/ASA 2013 Guideline for the Early Management of Patients With Acute Ischemic Stroke, which is endorsed by the American Academy of Neurological Surgeons and Congress of Neurological Surgeons, does not list TCD in their recommendations. TCD is discussed under intracranial vascular imaging stating, "Transcranial Doppler (TCD) ultrasonography has been used to detect intracranial vessel abnormalities. TCD has been used to evaluate occlusions and stenoses in intracranial vessels. TCD accuracy is less than that of CTA and MRA for steno-occlusive disease, with a sensitivity and specificity of TCD ranging from 55% to 90% and from 90% to 95%, respectively." "The usefulness of TCD is limited in patients with poor bony windows, and its overall accuracy is dependent on the experience of the technician, the interpreter, and the patient's vascular anatomy. For posterior circulation stroke, ultrasound is not helpful; CTA, MRA, or a conventional angiogram is required (Jauch, et al., 2013).

The updated 2012 AHA/ASA Guideline for the Management of Aneurysmal Subarachnoid Hemorrhage, which is endorsed by the American Academy of Neurological Surgeons and Congress of Neurological Surgeons, has recommendations under Management of Cerebral Vasospasm and delayed cerebral ischemia (DCI) after aneurysmal subarachnoid hemorrhage (aSAH) with a new recommendation stating: "Transcranial Doppler is reasonable to monitor for the development of arterial vasospasm (Class IIa; Level of Evidence B). Under Management of Cerebral Vasospasm and Delayed Cerebral Ischemia After aSAH another new recommendation states: "Transcranial Doppler is reasonable to monitor for the development of arterial vasospasm (Class IIa; Level of Evidence B)". Definition of Classes and Levels of Evidence Used in AHA Stroke Council Recommendations: Class IIa The weight of evidence or opinion is in favor of the procedure or treatment. Level of Evidence B Data derived from a single grade A study, or ≥ 1 case-control studies, or studies using a reference standard applied by an unmasked evaluator (Connolly, et al., 2012).

In the AHA/ASA scientific statement on the evaluation of transient ischemic attack the authors report under Class II Recommendations that: "Initial assessment of the extracranial vasculature may involve any of the following: carotid ultrasound/transcranial Doppler (CUS/TCD), magnetic resonance angiography (MRA), or computed tomographic angiography (CTA), depending on local availability and expertise, and characteristics of the patient (Class IIa, Level of Evidence B) (Easton, et al., 2009).

ACR Appropriateness Criteria®: ACR (American College of Radiology) appropriateness criteria are guidelines developed by expert panels in diagnostic imaging, interventional radiology, and radiation oncology. Transcranial Doppler (TCD) ultrasound is addressed in various ACR Appropriateness Criteria guidelines. The guidelines use the rating scale 1, 2, and 3: Usually not appropriate; 4, 5, and 6: May be appropriate; 7, 8, and 9: Usually appropriate (ACR, 2011; 2012).

Ataxia: Evaluating ataxia associated with various causes. Rating: 1 or 2

Head Trauma: Evaluating head trauma/skull fracture. Rating 1

Cerebrovascular Disease:

- Asymptomatic. Structural lesion on physical examination (cervical bruit) and/or risk factors. Rating 3
- Carotid territory or vertebrobasilar TIA, initial screening survey. Rating 3
- New focal neurologic defect, fixed or worsening. Less than 3 hours. Rating 3
- New focal neurologic defect, fixed or worsening. Three to 24 hours. Rating 2
- Risk of unruptured aneurysm. Positive family history. Rating 1
- Proven SAH by lumbar puncture or imaging. Rating 8 for vasospasm.
- Proven SAH, negative angiogram, follow-up. Rating 5 for vasospasm
- Clinically suspected parenchymal hemorrhage (hematoma), not yet confirmed. Rating 1

American College of Radiology (ACR), American Institute of Ultrasound in Medicine (AIUM), Society for Pediatric Radiology (SPR), Society of Radiologists in Ultrasound (SRU): The updated ACR-AIUM-SPR-SRU Practice Guideline for the Performance of TCD Ultrasound states that TCD is a noninvasive technique that assesses blood flow within the circle of Willis and the vertebrobasilar system. This practice guideline does not evaluate the quality of evidence and strength of recommendations for the specific clinical indications (ACR, 2012).

Indications for a TCD ultrasound examination of adults include, but are not limited to:

- Detection and follow-up of stenosis or occlusion in a major intracranial artery in the circle of Willis and vertebrobasilar system, including monitoring of thrombolytic therapy for acute stroke patients.
- Detection of cerebral vasculopathy
- Detection and monitoring of vasospasm in patients with spontaneous subarachnoid hemorrhage.
- Evaluation of collateral pathways of intracranial blood flow, including after intervention.
- Detection of circulating cerebral emboli.
- Detection of right-to-left shunts
- Assessment of cerebral vasomotor reactivity.
As an adjunct in the confirmation of the clinical diagnosis of brain death.
- Intraoperative and periprocedural monitoring to detect embolization, thrombosis, hypoperfusion, and hyperperfusion.
- Evaluation of sickle cell disease to determine the stroke risk.
- Assessment of arteriovenous malformations.
- Detection and follow-up of intracranial aneurysms.
- Evaluation of positional vertigo or syncope.

Additional applications in children include but are not limited to:

- Assessment of intracranial pressure and hydrocephalus.
- Assessment of hypoxic ischemic encephalopathy.
- Assessment of dural venous sinus patency.

The ACR Practice Guideline for the Performance of Neurosonography in Neonates and Young Children (2009) states that neurosonographic examinations should be conducted with a real-time scanner, preferably with transducers that can fit within and image through the anterior fontanelle. If the anterior fontanelle is not available, imaging may be performed through other sutural openings or by using a transcranial approach, usually with a lower-frequency transducer penetrating the squamosal portion of the temporal bone. The transducer or scanner should be adjusted to operate at the highest clinically appropriate frequency, recognizing that there is a trade-off between resolution and beam penetration. Doppler sonography or color Doppler sonography may be used to evaluate intracranial blood flow in selected cases. The guideline notes that neonatal sonographic examinations should be performed on the neonate or young child (defined primarily as those who have had no closure of the anterior fontanelle) for a valid reason, such as to determine the presence or absence of hemorrhage, parenchymal abnormalities, ventricular dilation, congenital abnormalities and vascular abnormalities. There has been no update to this guideline since 2009.

American Society of Neurophysiologic Monitoring (ASNM) and American Society of Neuroimaging

(ASN): The Guideline Committees of the ASNM and ASN formed a joint task force to develop practice guidelines for TCD monitoring in the surgical and intensive care settings (Edmonds, et al., 2011). The authors report that the primary goals of developing the guidelines are to (1) delineate the objectives of TCD monitoring; (2) characterize the responsibilities and behaviors of the sonographer during monitoring; and (3) describe methodological and ethical issues uniquely relevant to TCD monitoring. The guideline does not define Class level evidence and Type recommendations. The ASNM and ASN major recommendation include the following:

- acquisition and interpretation of intraoperative TCD ultrasonograms should be performed by qualified individuals and service providers define their diagnostic criteria and develop ongoing self-validation programs of these performance criteria in their practices. It agrees with the guidelines of other professional societies regarding the technical and professional qualifications of individuals responsible for TCD signal acquisition and interpretation. (Class III evidence, Type C recommendation).
- On the basis of current clinical literature and scientific evidence, TCD monitoring is an established monitoring modality for the: (1) assessment of cerebral vasomotor reactivity and autoregulation; (2) documentation of the circle of Willis functional status; (3) identification of relative cerebral hypo- and hyperperfusion; and (4) detection of cerebral emboli. (Class II and III evidence, Type B recommendation).

The American College of Cardiology Foundation (ACCF) and the American Heart Association (AHA) along with experts in multiple specialties and professional societies/organizations developed Guidelines on the

Management of Patients with Extracranial Carotid and Vertebral Artery Disease. In the section on diagnosis and testing the authors state that, "with carotid duplex sonography, transcranial Doppler sonography, MRI, and radionuclide imaging to assess cerebral perfusion, there is no convincing evidence that available imaging methods reliably predict the risk of subsequent stroke, and there is no adequate foundation on which to recommend the broad application of these techniques for evaluation of patients with cervical arterial disease" (Brott, et al., 2011). No quality of evidence and/or strength of recommendations were in the guideline for TCD.

Use Outside of the US (For Informational Purposes Only)

No relevant information found.

Summary

The American Academy of Neurology's (AAN) Assessment: Transcranial Doppler (TCD) Ultrasonography concluded that TCD is of established value in the screening of children age 2–16 years with sickle-cell disease for stroke risk and the detection and monitoring of angiographic vasospasm (VSP) after nontraumatic (spontaneous) subarachnoid hemorrhage (SAH). The AAN report states that TCD monitoring is able to provide information and is probably useful to detect hemodynamic and embolic events that may result in perioperative stroke during and after carotid endarterectomy (CEA). Additionally, there is evidence in peer-reviewed published studies and textbook literature that TCD is an accepted method for monitoring cerebral blood flow to detect embolic events during and after CEA.

Although TCD may be able to provide some information, the diagnostic utility of TCD compared to that of other established diagnostic tools remains to be determined or has not been established for numerous indications and applications including, but not limited to, the evaluation of intracranial steno-occlusive disease and in the determination of cerebral circulatory arrest/brain death. According to the AAN report, the clinical utility of TCD has not been established for cerebral thrombolysis, cerebral microembolism detection, coronary artery bypass graft (CABG) surgery, vasomotor reactivity (VMR) testing (i.e., vasoreactive study), vasospasm after traumatic subarachnoid hemorrhage, and transcranial color-coded sonography. Other diagnostic tests are typically preferable for right-to-left cardiac shunts and extracranial internal carotid artery (ICA) stenosis.

Coding/Billing Information

Note: 1) This list of codes may not be all-inclusive.

2) Deleted codes and codes which are not effective at the time the service is rendered may not be eligible for reimbursement.

Covered when medically necessary:

CPT[®]* Codes	Description
93886	Transcranial Doppler study of the intracranial arteries; complete study
93888	Transcranial Doppler study of the intracranial arteries; limited study

Experimental/Investigational/Unproven/Not Covered:

CPT* Codes	Description
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

***Current Procedural Terminology (CPT[®]) © 2012 American Medical Association: Chicago, IL.**

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