SUMMARY

Transcranial Doppler sonography is a non- invasive method of assessing the blood flow velocity and pulsatility of the intracranial arteries ,and since there are interindividual variations.The best results can be obtained by comparing velocities and pulsatilites from the two sides and comparing measurments from the same subject at various times and under different conditions of physiologic and pharmacologic stimulation or compression of various extracranial arteries ***(Aaslid et al.,1982 & Kelly et al.,1990)***

Transcranial Doppler (TCD) ultrasonography is a noninvasive ultrasonic technique that uses a hand-held low-frequency (i.e., 2–2.5 megahertz [MHz]) sector transducer that sends fixed or pulsed sound waves to measure the velocity of blood flowing in the basal arteries of the brain. Sound waves are transmitted through temporal, orbital, and suboccipital acoustic windows of the skull. When the sound waves come in contact with blood, they are reflected off the red blood cells through the brain and skull to a detector. The velocity of the sound waves reflected to the surface is changed because the blood cells themselves are in motion toward, or away, from the sound wave detector. This is called Doppler shift and is directly related to the velocity and flow of the blood cells. The velocity of the blood cells is faster during systole and slower during diastole. The blood in the center of the lumen moves quicker than the blood near the vessel wall. A spectrum of flow velocities is produced. TCD measurements of flow velocity are commonly made in the middle cerebral artery. Other arteries that may be measured by TCD include the anterior cerebral, anterior communicating, posterior cerebral and communicating, and basilar arteries ***(Chernecky et al., 2008; Mahla et al., 2005)***

TCD is used primarily to evaluate and manage patients with cerebrovascular disease. Conventional and digital subtraction angiography (DSA) constitute the reference standard for evaluating patency and degree of stenosis in intracranial vessels. TCD is operator-dependent and requires training and experience to perform and interpret results. Diagnostic ultrasound examinations should be supervised and interpreted by trained and qualified physicians TCD can be performed by sonographers, technologists, and physicians. Interpretation of TCD measurements is performed by neurologists and other specialists ***(Sloan, et al., 2004)***

An advantage of TCD is that it can be performed at the bedside and repeated as needed or applied for continuous monitoring. A limitation to TCD is that it can only record cerebral blood flow velocities in certain segments of large intranial vessels, although large vessel intracranial arterial disease commonly occurs at these locations ***(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

- False-Negative exams of vasospasm are associated with chronic high blood pressure, increased intracranial pressure, severe spasm of the carotid siphon, and distal vasospasm

- Tobacco and caffeine use

- 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

There are many proposed applications for TCD including, but not limited to, the following ***(Chernecky and Berger, 2008; American Academy of Neurology [AAN], 2006)***:

• 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 (CO_2) 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

A report for the complete diagnostic TCD examination should contain, at a minimum:

1. Date and time of the examination;
2. Patient name, demographics, medical record number
3. Indications;
4. A description of the test that was performed;
5. A statement of the data obtained;
6. Reasons for unsuccessful evaluation, i.e. absent temporal windows;
7. Interpretation of the ultrasound examination data;
8. A comparison with results from previous examinations, if applicable;
9. Clinical implications of this study

(Alexandrov ; et al.,2007)