Summary & conclusion

The development of the Transcranial Doppler devices in1982 was an important step in the clinical research of clinical hemodynamic conditions of the intracranial circulation. Subsequent advances in ultrasound technology have seen the use of combination Doppler blood flow imaging and B mode tissue imaging, so-called transcranial colour-coded duplex. This more precisely identifies vessels and, if required, the direction of flow. Doppler beam angle correction gives a more accurate estimate of blood flow velocity in areas of arterial tortuosity.

Nowadays, because of the wide availability of the noninvasive vascular imaging techniques such as transcranial Doppler ultrasonography (TCD) and transcranial color-coded duplex ultrasonography (TCCD), obstructive disease of the middle cerebral artery (MCA) and of other major intracranial brain–supplying arteries is increasingly detected in stroke patients as well as in asymptomatic individuals.

Transcranial ultrasound can rapidly and non-invasively image blood flow in the major basal intracranial arteries. Its accuracy makes it acceptable for detection of intracranial hemodynamic derangements such as arterial stenosis, arterial occlusion, collaterals and microembolization. Transcranial Doppler ultrasound or transcranial colour-coded duplex have major advantages: The procedure is noninvasive, nonionizing, portable, safe for serial or prolonged studies, and can be performed at the bedside and repeated as needed or applied for continuous monitoring; it is frequently less

expensive than other techniques; and iodinated contrast agents are not used. On the other hand, they provide inferior spatial and anatomical detail in comparison to angiographic techniques. Although it has a relatively limited field of view and is not technically feasible in approximately 10% of cases, the information obtained is becoming increasingly relevant to therapeutic decision-making in the prevention and management of stroke. These proportions can be reduced to less than 5% with the use of intravenous transpulmonary echo-contrast drugs, however, these drugs increase the cost of the investigation.

Transcranial Doppler sonography can be used to diagnose stenoses of the middle cerebral artery, terminal internal carotid artery, vertebrobasilar system, and, less reliably, the anterior and posterior cerebral arteries, with a high sensitivity especially for the middle cerebral artery lesions.

Several TCD criteria for the diagnosis of cerebro-vascular lesions have been described, but the criteria differ considerably among authors. In the majority of reports, a focal area of increase in mean velocity (MV) and an absence of flow signals are the main findings reflecting an intracranial vascular lesion; other criteria such as focal area of spectral waveform abnormalities including turbulence, murmur, dampened signals, blunted signals, or minimal flow signals; and compensatory increase in MV in collateral vessels and flow inversion to the anterior or posterior cerebral artery or to perforators are regarded as supporting features.

The diagnostic accuracy of TCCS depends on the knowledge, skill, and experience of the examiner, who must be familiar with the anatomy and

physiology of the intracranial vasculature and the pathophysiology of stroke and other neurovascular diseases. In most cases, the clearest understanding of the transcranial Doppler data requires an integration with the results of other neuroradiologic studies and clinical and laboratory determination. We must take in consideration that the evaluation of the steno-occlusive lesions is not the only application of TCD in cases of cerebro-vascular stroke.

TCD can be also used to evaluate a spectrum of vascular abnormalities related to this disease:

- Evaluate coexisting routes of collateral circulation.
- Vasomotor reactivity (VMR) testing, for the detection of impaired cerebral hemodynamics.
- Cerebral microembolism detection.
- Detection and follow-up of vasoconstriction caused by subarachnoid hemorrhage, which may result in an ischemic lesion.
- Determination of brain death.
- In the operating room or angiographic suite, to monitor patients undergoing surgical, interventional, or diagnostic procedures for the development of cerebrovascular complications.
- Predict the risk of stroke in children with sickle cell anemia.
- Monitoring thrombolysis of acute middle cerebral artery occlusions.
- Detect the hemodynamic consequences of associated extracranial ICA stenosis, which may be the etiology of an embolic infarction at the MCA territory.

In conclusion Color-coded transcranial Doppler sonography is a safe, non-invasive, rapid, low cost and reliable method in assessment and follow up of these cases.

It can provide real-time flow findings that are complementary to information provided by other imaging modalities.

It can be also used to evaluate a spectrum of vascular abnormalities related to the cerebro-vascular steno-occlusive lesions.

However, further studies are required to determine optimal velocity values, to set clear and solid criteria to quantify the stenotic lesions aiming to develop a screening test with balanced performance parameters