TCCD: Intracranial Vessel Detection

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The blood supply to the human brain is provided by two pairs of arteries: the Internal Carotid and the Vertebral, right and left. Vertebral arteries join together giving rise to the Basilar Artery which finishes dividing into the Cerebral Posterior arteries; these tie up with the Internal Carotids through the Posterior Communicating Arteries. The Internal Carotids give origin to the Middle and Anterior Cerebral arteries, the latter connected between them by the Anterior Communicant artery. An anastomotic ring placed to the floor of the brain, known as Willis Polygon, is realized in the end.
From the polygon originate then 3 pairs of arteries: the Anterior Cerebral, the Middle Cerebral and the Posterior Cerebral arteries, lying on the outer brain surface and progressively dividing into smaller and smaller arteries which penetrate the parenchyma feeding specific regions.
Arteries arising from the Willis Polygon can be explored with TCCD, by identifying the signal of the blood flow, through 3 windows, that allow the ultrasound passing through: the Temporal, the Ophthalmic and the Occipital window. The Temporal window appear insufficient in about the 15-20% of the cases, especially the elderly female population; seldom the occipital window appear insufficient. The use of modern contrast means almost completely remove the obstacle to the exploration, represented by the "hostile" window.

TCCD: Pathological Findings

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In the management of patients with acute stroke the neurosonological evaluation with TCCS (Transcranial Colour Coded Sonography) is strongly recommended in order to achieve in emergency some useful informations. Particularly in the acute phase of stroke, in spite of a brain CT scan substantially free of abnormalities, we can identify the pattern of extra- and intracranial vessel occlusion and then use this data for therapeutical and prognostical purposes. Indeed some occlusive pattern, as T type occlusion, i.e. occlusion of intracranial internal carotid artery, middle cerebral artery and anterior cerebral artery, and tandem occlusion of internal carotid artery and middle cerebral artery are known to have poor recanalization rates after intravenous thrombolysis. Another information is done by the monitoring of recanalization of occluded vessels during treatment, because the speed of this process is mainly related to functional outcome. The accepted threshold for a better outcome is the vessel recanalization within 30 minutes from the administration of thrombolysis, and after this time more aggressive strategies of treatment are needed to achieve a rapid and complete recanalization. In the acute phase of stroke TCCS can be used for performing a perfusional study too, showing the real presumed size of the hypoperfused area in the brain. This approach is in progress, in order to define the penumbra and core thresholds, in comparison with neuroradiological techniques, and it is promising for a complete neurosonological evaluation of acute stroke patients as a guide to the better treatment.

Cerebral Venous System

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Ultrasound examination of cerebral veins and sinuses is a new application, which has been developed during the recent years. In the acute phase of cerebral vein and sinus thrombosis (CVT) occlusion of dural sinuses may be diagnosed by transcranial color-coded duplex sonography (TCCS) after echo contrast-agent application demonstrating a filling defect. However, since parts of the venous system cannot be insonated exclusion of CVT is not possible by TCCS.
Venous collaterals are important for the clinical course of the disease. Collateral venous flow can be assessed by both transcranial Doppler sonography and TCCS. Although ultrasonographic techniques are not sensitive enough to exclude cerebral venous thrombosis, they may complement other non-invasive imaging techniques which are not able to give informations on collateral pathways. In the follow-up, sonographic findings are related to the functional outcome.
Venous TCCS has also been applied in subarachnoid hemorrhage, head trauma or space occupying stroke. The results are summarized in the presentation.