

TCD and Alzheimers Disease/dementia

Background:

Cerebrovascular disease may contribute to the development and progression of Alzheimer's disease (AD).

It is subject to research, to determine if TCD allows differentiation between Alzheimers disease and vascular dementia and if TCD is helpful in early diagnosis of both.

Literature:

Utility of transcranial ultrasound in predicting Alzheimer's disease risk.

Author	<u>Tomek A¹, Urbanová B¹, Hort J¹.</u>
Content/Summary Abstract	Alzheimer's disease (AD) is a progressive, neurodegenerative disease characterized by an increasing incidence. One of the pathologic processes that underlie this disorder is impairment of brain microvasculature. Transcranial ultrasound is a non-invasive examination of cerebral blood flow that can be employed as a simple and useful screening tool for assessing the vascular status of brain circulation in preclinical and clinical stages of AD. The objective of this review is to explore the utility of using a transcranial ultrasound to diagnose AD. With transcranial ultrasound, the most frequently studied parameters are cerebral blood flow velocities and pulsatility indices, cerebrovascular reserve capacity, and cerebral microembolization.
Comment	Authors recommend using as a transcranial Doppler sonography screening method of choice the assessment of cerebrovascular reserve capacity with breath-holding test
Doppler-device	Not known
Quantification	An interesting review on different applications of TCD in the assessment of dementia.

Blood flow velocity changes in anterior cerebral arteries during cognitive tasks performance.

Author	Boban M ¹ , Crnac P ² , Junaković A ³ , Garami Z ⁴ , Malojčić B ⁵ .
Content/Summary Abstract	<p>OBJECTIVE:</p> <p>Transcranial Doppler sonography (TCD) enables monitoring of blood flow velocities (BFVs) in basal cerebral arteries during different cognitive tasks performance with great temporal resolution. So far, BFVs changes during mental activity were monitored primarily in middle cerebral arteries (MCAs) and little is known about these changes in anterior cerebral arteries (ACAs).</p> <p>AIM:</p> <p>To determine the effect of different cognitive tasks performance on BFV changes and hemispheric dominance in ACAs and to assess the most suitable activation test for monitoring of BFV changes in ACAs.</p> <p>METHODS:</p> <p>Fourteen right-handed, healthy subjects aged 20-26 were included in the study. BFVs in both ACAs were recorded simultaneously during performance of cognitive tasks designed to activate frontal lobes: phonemic verbal fluency test (pVFT), Stroop tests and Trail Making Tests (TMTs).</p> <p>RESULTS:</p> <p>A statistically significant BFV increase was recorded in both ACAs during performance of all cognitive tasks. Statistically significant right ACA dominance was found during performance of pVFT and TMTB. The most significant BFV increase was obtained during performance of TMTB.</p>
Comment	<p>Authors result addressed cognitive tests with great activation potential for monitoring of ACAs that might be used in distinguishing of healthy individuals and patients with neurovascular or neurodegenerative diseases.</p>
Doppler-device	Doppler-BoxX, DWL
Quantification	<p>One of the first studies examining blood flow changes in the anterior cerebral arteries triggered by cognitive paradigms designed to stimulate frontal cortex.</p>

Transcranial Doppler to measure cerebral blood flow in delirium superimposed on dementia. A cohort study.

Author	Caplan GA ¹ , Lan Z ² , Newton L ³ , Kvelde T ⁴ , McVeigh C ³ , Hill MA ² .
Content/Summary Abstract	OBJECTIVE: Delirium superimposed on dementia (DSD) is frequently not diagnosed, at great cost. Both delirium and dementia are associated with cerebral hypoperfusion. A switch to anaerobic glycolysis in the central nervous system during delirium compared to Alzheimer's dementia (AD) suggests greater hypoperfusion in DSD. The main aims of this study were to investigate whether cerebral hypoperfusion could differentiate DSD from related entities, and the characteristics of that hypoperfusion.
Comment	Prospective cohort study of 44 Geriatric Medicine patients in 4 groups: (1) delirium, no history of dementia; (2) DSD; (3) acute illness without delirium or dementia; and (4) AD, no delirium. We measured CBF using transcranial Doppler to assess flow velocity (FV) and pulsatility index in the middle cerebral artery (MCA).
Doppler-device	Not known
Quantification	Transcranial Doppler is a potential diagnostic and monitoring test for DSD. Correlation with clinical indicators of delirium suggests pathophysiological significance. Crown Copyright © 2014. Published by Elsevier Inc. All rights reserved.

Head position and cerebral blood flow velocity in acute ischemic stroke: a systematic review and meta-analysis.

Author	Olavarría VV¹ , Arima H , Anderson CS , Brunser AM , Muñoz-Venturelli P , Heritier S , Lavados PM .
Content/Summary Abstract	BACKGROUND: Patients with acute ischemic stroke (AIS) have impaired vasomotor reactivity, especially in the affected cerebral hemisphere, such that they may depend directly on systemic blood pressure to maintain perfusion to vulnerable 'at risk' penumbral tissue. As the sitting up position may affect cerebral perfusion by decreasing cerebral blood flow (CBF) in salvageable tissue, positioning AIS patients with their head in a lying flat position could increase CBF through collateral circulation or gravitational force. We wished to quantify the effect of different head positions on meanflow velocity (MFV) by transcranial Doppler ultrasonography (TCD) in AIS patients to assess the potential for benefit (or harm) of head positioning in a clinical trial.
Comment	Authors performed a systematic review and meta-analysis of observational studies with TCD to evaluate differences in cerebral MFV between the lying flat and sitting up head positions in AIS. For each study and each comparison, we obtained the mean value of changes in MFV and its variance.
Doppler-device	Not known
Quantification	In AIS patients, MFV increased significantly in the side affected by the stroke but not in the unaffected side when they were positioned in a lying flat head position at 0 or 15° compared to an upright head position at 30°. The clinical significance of these findings is now undergoing further randomized evaluation in the international multicenter Head Position in Acute Stroke Trial (HeadPoST).

Major Orthopaedic Surgery Leads to Gaseous Cerebral Microembolism

Author	Kietaihl C1, Engel A1, Horvat Menih I1, Windhager R2, Markstaller K1, Klein KU1
Content/Summary Abstract	<p>Background: Cerebral microemboli (ME), detectable with transcranial Doppler (TCD) ultrasound, are frequently generated during major orthopaedic surgery. However, to date scant attention was set on the nature of ME. Novel TCD ultrasound software algorithm (DWL Doppler BoxX, Compumedics Germany GmbH) allows for the differentiation between particulate and gaseous ME.</p> <p>Method: Fifty orthopaedic patients (hip/knee/shoulder prosthesis, spine surgery > 3 hours) undergoing general anaesthesia were examined. Exclusion criteria were: age < 50 or > 90 years, severe valvular heart defect and acute neurological disorders. Using the ultrasound device DWL Doppler BoxX, cerebral ME, detected as high intensity transient signals (HITS), were recorded in both middle cerebral arteries (MCAs) for 15 minutes prior and after the operation (measurement settings: threshold of 9 dB using a sample volume of 8 mm at a pulse repetition frequency of 7 kHz).</p> <p>Main findings and conclusion: The results reveal that primarily gaseous cerebral ME increase after major orthopaedic surgery. Additionally, a low mean CBFV and a potentially impaired CO₂-reactivity of the cerebral vasculature was observed. The impact of these factors on neurologic and overall patient outcome needs to be investigated in the future.</p>
Comment	Interesting study that shows how to use and differentiate the embolic signals during orthopaedic surgery (quantify (ME load) and qualify (particulate vs. gaseous)).
Doppler-device	Doppler Boxx, DWL Compumedics Germany
Quantification	<p>Transcranial Doppler is a potential diagnostic and monitoring test for DSD. Correlation with clinical indicators of delirium suggests pathophysiological significance.</p> <p>Crown Copyright © 2014. Published by Elsevier Inc. All rights reserved.</p>

Transcranial Doppler to measure cerebral blood flow in delirium superimposed on dementia. A cohort study.

Author	(Caplan GA ¹ , Lan Z ² , Newton L ³ , Kvelde T ⁴ , McVeigh C ³ , Hill MA ² . ., 2014)
Content/Summary	Delirium superimposed on dementia (DSD) is frequently not diagnosed, at great cost. Both delirium and dementia are associated with cerebral hypoperfusion. A switch to anaerobic glycolysis in the central nervous system during delirium compared to Alzheimer's dementia (AD) suggests greater hypoperfusion in DSD. The main aims of this study were to investigate whether cerebral hypoperfusion could differentiate DSD from related entities, and the characteristics of that hypoperfusion.
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Doppler-device	Not known
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Comment	Authors performed a systematic review and meta-analysis of observational studies with TCD to evaluate differences in cerebral MFV between the lying flat and sitting up head positions in AIS. For each study and each comparison, we obtained the mean value of changes in MFV and its variance
Doppler-device	Not known

Quantification	In AIS patients, MFV increased significantly in the side affected by the stroke but not in the unaffected side when they were positioned in a lying flat head position at 0 or 15° compared to an upright head position at 30°. The clinical significance of these findings is now undergoing further randomized evaluation in the international multicenter Head Position in Acute Stroke Trial (HeadPoST).
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Transcranial Doppler ultrasound blood flow velocity and pulsatility index as systemic indicators for Alzheimer's disease.

Author	(Roher u. a., 2011)
Content/Summary	Our study showed that decreased arterial mean flow velocity and increased pulsatility index are associated with a clinical diagnosis of presumptive AD. Cerebral blood flow impairment shown by these parameters reflects the Not known global hemodynamic and structural consequences of a multifaceted disease process yielding diffuse congestive microvascular pathology, increased arterial rigidity, and decreased arterial compliance, combined with putative age-associated cardiovascular output declines.
Comment	
Doppler-device	Not known
Quantification	TCD evaluation offers direct physical confirmation of brain perfusion impairment and might ultimately provide a convenient and a noninvasive means to assess the efficacy of medical interventions on cerebral blood flow or reveal incipient AD. In the near term, TCD-based direct assessments of brain perfusion might offer the prospect of preventing or mitigating AD simply by revealing patients who would benefit from interventions to improve circulatory system function.

Vasoreactivity induced by acetazolamide in patients with vascular dementia versus Alzheimer's disease.

Author	(Likitjaroen u. a., 2009)
Content/Summary	Average ages of VaD and AD groups were 66.11 years-old and 75.22 years-old respectively. Mini-mental State Examination (MMSE) score in VaD and AD were 21.13 and 19.00. Mean baseline EDV and MSV in VaD were higher than AD but mean PSV was lower. The percentage of velocity change after acetazolamide in AD was higher than VaD at 5, 10 and 20 min. However the differences were not statistically significant.
Comment	Nine AD (5 males) and 9 VaD (6 males) were selected.
Doppler-device	DWL Multi Dop T
Quantification	Acetazolamide vasoreactive test using TCD may be the additional criterion to differentiate VaD from AD. Further study with more number of subjects for the study or higher dose of acetazolamide may be needed to reveal the

	significant difference of vasoreactive response between VaD and AD patients.
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Altered cerebral hemodynamics in early Alzheimer disease: a pilot study using transcranial Doppler.

Author	(Claassen u. a., 2009)
Content/Summary	Compared to controls, AD patients had lower CBFV and higher cerebrovascular resistance index, unexplained by brain atrophy. However, CBFV variability was reduced despite enhanced BP variability, and dynamic cerebral autoregulation was not impaired.
Comment	Nine patients with mild AD and eight cognitively normal controls
Doppler-device	Not known
Quantification	In conclusion, despite a distinct pattern of altered cerebral hemodynamics, AD patients may have normal autoregulation. However, the challenges for autoregulation in AD are higher, as our data show enhanced BP fluctuations. Increased cerebral vasoconstriction or reduced vasomotion also may attenuate CBFV variability.

Cerebrovascular reactivity in degenerative and vascular dementia: a transcranial Doppler study.

Author	(Vicenzini u. a., 2007)
Content/Summary	Reduced FV and increased PI with a significant vasoreactivity reduction in VaD and AD patients are indicators of impairment of cerebral microvasculature circulation in both diseases. AD and VaD patients did not show significant differences in FV, PI values or cerebral vasoreactivity.
Comment	We studied 60 AD and 58 VaD patients and 62 nondemented controls.
Doppler-device	MultiDop X4, DWL
Quantification	The identification of vascular function impairment in all kinds of dementia could be of help in identifying patients who would thus benefit more from specific therapeutic approaches.

Transcranial and extracranial ultrasound assessment of cerebral hemodynamics in vascular and Alzheimer's dementia.

Author	(Doepp u. a., 2006)
Content/Summary	MCA V(mean) in VD (36 +/- 8 cm/s) and AD (43 +/- 13 cm/s) were significantly lower than in controls (59 +/- 13 cm/s) but did not differ significantly between VD and AD groups. PI (1.1 +/- 0.2; 1 +/- 0.2; 0.9 +/- 0.2) only differed significantly between VD group and controls. CBF and CCT in VD (570 +/- 61 ml/min; 8.8 +/- 2.6 s) and AD (578 +/- 77 ml/min; 8.2 +/- 1.4 s) were similar but differed significantly from controls (733 +/- 54 ml/min; 6.4 +/- 0.8 s). BVF in the anterior and posterior circulation of VD group (412 +/- 62 and 158 +/- 38 ml/min) and AD group (428 +/- 62 and 150 +/- 41 ml/min) were significantly lower than in controls (537 +/- 48 and 199 +/- 26 ml/min) but did not differ significantly between the

	patient groups.
Comment	Twenty VD and 20 AD patients were studied and compared with 12 age-matched controls.
Doppler-device	Not known
Quantification	Transcranial and extracranial ultrasound does not help to distinguish between VD and AD.

Differentiation of vascular dementia and Alzheimer disease: a functional transcranial Doppler ultrasonographic study.

Author	(Asil und Uzuner, 2005)
Content/Summary	Reactivity to visual stimulation was similar for the patients with AD (mean +/- SD, 38% +/- 2.2%) and control subjects (35% +/- 1.8%), but reactivity was found significantly decreased in both sides of patients with VD (25.7% +/- 2.1% for the left side and 24% +/- 2.6% for the right side) compared with the healthy control subjects and the patients with AD (P < .001).
Comment	Fifteen patients with AD (mean age, 70 years), 12 patients with vascular dementia (VD) (mean age, 61.5 years), and 9 healthy control subjects (mean age, 58 years) were enrolled in the study.
Doppler-device	Not known
Quantification	These results indicate that the occipital cortex is partially preserved in patients with AD and that functional TDU may be a valuable tool for differentiating VD and AD.

Summary:

Assessment of absolute BFV or PI cannot differentiate between VaD and AD. Acetazolamide vasoreactive test using TCD may be the additional criterion to differentiate VaD from AD. Probably the occipital cortex may be unaffected in AD and thus TCD may allow to differentiate due to fTCD.

Experts:

No one in particular

Literature

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