

TCD and cardiac arrest

Background:

An effective tissue perfusion has decisive influence on the final prognosis both during cardiopulmonary resuscitation (CPR) and after recovery of spontaneous circulation (ROSC). The transcranial Doppler ultrasonography (TCD) examines the velocity and pulsatility of cerebral blood flow, making it possible to perform "beat to beat" hemodynamic analysis. This may make it possible to estimate outcome after resuscitation. During CPR, TCD peak systolic velocity reflects cerebral perfusion of the chest compressions.

Literature:

Transcranial Doppler ultrasound in therapeutic hypothermia for children after resuscitation.

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| Author | Lin JJ ¹ , Hsia SH ² , Wang HS ² , Chiang MC ³ , Lin KL ⁴ . |
| Content/Summary Abstract | <p>AIM OF THE STUDY: The aim of the present study was to assess the cerebral flow in children receiving therapeutic hypothermia after resuscitation. The prognostic value of transcranial Doppler findings was correlated with the clinical outcomes in these children.</p> <p>METHODS: A retrospective cohort study was conducted at the paediatric intensive care unit of Chang Gung Children's Hospital between January 2011 and December 2012. All children from 1 month to 18 years of age who received therapeutic hypothermia after resuscitation were eligible. Serialtranscranial Doppler examinations were performed and the findings were reviewed.</p> <p>RESULTS: Seventeen children met the eligibility criteria for this study. Fourteen patients (82.3%) were asphyxial in aetiology, and 12 (70.5%) of these cases occurred outside of the hospital. Eight patients (47.1%) had a Paediatric Cerebral Performance Score of 1 or 2 at 3 months after the events. Reversal diastolic or undetectable flow patterns during therapeutic hypothermia were associated with unfavourable prognosis. Normal mean flow velocity in the rewarming phase and normal pulsatility index in the hypothermia and rewarming phases were associated with favourable outcome.</p> |
| Comment | important study that includes children from age of 1 month till 18 years |
| Doppler-device | Not known |
| Quantification | The transcranial Doppler examinations provided additional information for cerebral perfusion during therapeutic hypothermia, which may in the future be used to guide changes to hypothermia management. Mean cerebral blood flow velocity and pulsatility index |

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| | by transcranial Doppler sonography can serve as a prognostic factor for children who receive therapeutic hypothermia after resuscitation. |
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Transcranial Doppler ultrasound use in post-cardiac arrest coma

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| Author | (Alvarez-Fernandez, 2011) |
| Content/Summary | In patients who remain comatose two hours after being recovered from cardiac arrest, persistence in the cerebral arteries of a diffuse hypodynamic TCD pattern (low medium velocity and high pulsatility) also predicts poor neurologic recovery. Early or late presence of a diffuse hyperdynamic TCD pattern (high medium velocity and low pulsatility) is also associated with poor prognosis because progression to intracranial hypertension and brain death. Coincidence of hypodynamic arteries and other with normal or hyperdynamic TCD patterns, suggests foci of hypoperfusion that may be predictors of stroke. |
| Comment | Article in Spanish. Review. |
| Doppler-device | None |
| Quantification | Using serial TCD examinations in comatose patients after initial recovery from cardiac arrest, to detect and treat early changes in cerebral hemodynamics, will decrease the likelihood of secondary neurological damage. In the first 24 hours, TCD could identify patients who have progressed to irreversible neurological damage, thus avoiding therapeutic futility. |

Transcranial Doppler ultrasonography usefulness in cardiac arrest resuscitation

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| Author | (Álvarez-Fernández u. a., 2010) |
| Content/Summary | Beyond 2 hours after ROSC, persistence in the cerebral arteries of a hemodynamic TCD pattern (low velocities with high pulsilities) predicts poor neurological prognosis. Early or delayed presence of a hyperemic TCD pattern (high velocities with low pulsilities) is associated conclusively with evolution to intracranial hypertension and its appearance during the rewarming process should lead to immediate return to therapeutic hypothermia. |
| Comment | Article in Spanish |
| Doppler-device | None |
| Quantification | See content |

Preserved metabolic coupling and cerebrovascular reactivity during mild hypothermia after cardiac arrest.

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| Author | (Bisschops u. a., 2010) |
| Content/Summary | |
| Comment | All patients were cooled to 32-34 degrees C for 24 hrs. Cerebrovascular reactivity to changes in carbon dioxide in the arterial blood was measured after increasing or decreasing the minute ventilation by 20%. |
| Doppler-device | Sonosite M-Turbo; Sonoview Nederland BV, Rijswijk, The Netherlands |
| Quantification | The mean flow velocity in the middle cerebral artery, as a parameter of cerebral blood flow, was low during mild hypothermia, whereas cerebral oxygen extraction remained normal, suggesting decreased cerebral metabolic activity. We demonstrated that CO ₂ reactivity is preserved during hypothermia in these patients. |

Cerebral flow pattern monitoring by transcranial Doppler during cardiopulmonary resuscitation.

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| Author | (Blumenstein u. a., 2010) |
| Content/Summary | The transcranial Doppler provided additional information during cardiopulmonary resuscitation, which was helpful in clinical management. The use of transcranial Doppler may be helpful for other cardiac procedures where cerebral malperfusion may occur. |
| Comment | Case report |
| Doppler-device | Not known |
| Quantification | TCD measurements reflect cardiac output during resuscitation. |

The prognostic value of early transcranial Doppler ultrasound following cardiopulmonary resuscitation.

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| Author | (Wessels u. a., 2006) |
| Content/Summary | Four and 72 h after CPR, peak systolic flow velocities in the middle cerebral artery (MCA) were significantly higher in group 1 than in group 2 ($p < 0.05$). Twenty-four h after CPR, peak systolic and diastolic flow velocities in the ACA and PCA were also significantly higher in group 1 than in group 2 ($p < 0.05$). At this time, patients of group 2 showed significantly higher resistance index-values ($RI = (sys-dia)/sys$) in the anterior cerebral artery (ACA) and the posterior cerebral artery (PCA) ($p < 0.05$). A high correlation between peak systolic blood flow velocity in the MCA and systemic systolic blood pressure was observed in group 2 early 4 to 16 h after CPR ($r = +0.52$ to $+ 0.81$, $p < 0.05$), while there was no such correlation in group 1. |
| Comment | Thirty-nine patients (27 men, 12 women) aged 66 ± 15 y (\pm -SD) who had undergone CPR were involved. Serial TCD examinations of the intracranial arteries were performed 1.5, 4, 8, 16, 24 and 72 h after CPR. Group 1 (survivor with good neurological status); group 2 (died patients). |
| Doppler-device | Not known |
| Quantification | Using serial TCD examinations, patients with severely disabling or fatal outcome could be identified within the first 24 h. Besides established clinical and laboratory parameters, postanoxic myoclonus and NSE, serial TCD examinations following CPR may be helpful to predict the clinical outcome, but further studies with a larger number of patients are necessary to approve this hypothesis. |

Summary:

In the first 24 hours, TCD might identify patients who have progressed to irreversible neurological damage.

TCD measurements reflect cardiac output during resuscitation.

Experts:

Alvarez-Fernandez
Wessels, Klötzsch

Literature

Álvarez-Fernández JA, Martín-Velasco MM, Igeño-Cano JC, Pérez-Quintero R. [Transcranial Doppler ultrasonography usefulness in cardiac arrest resuscitation]. *Med Intensiva* 2010; 34: 550-558.[zitiert 2011 Okt 29]

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Bisschops LLA, Hoedemaekers CWE, Simons KS, van der Hoeven JG. Preserved metabolic coupling and cerebrovascular reactivity during mild hypothermia after cardiac arrest. *Crit. Care Med.* 2010; 38: 1542-1547.[zitiert 2011 Dez 10]

Blumenstein J, Kempfert J, Walther T, Van Linden A, Fassl J, Borger M, u. a. Cerebral flow pattern monitoring by transcranial Doppler during cardiopulmonary resuscitation. *Anaesth Intensive Care* 2010; 38: 376-380.[zitiert 2011 Okt 31]

Wessels T, Harrer JU, Jacke C, Janssens U, Klötzsch C. The prognostic value of early transcranial Doppler ultrasound following cardiopulmonary resuscitation. *Ultrasound Med Biol* 2006; 32: 1845-1851.[zitiert 2011 Nov 2]

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