Cerebral metabolites, proteins and cerebral blood flow in patients with subarachnoid hemorrhage, delayed ischaemic neurological deficits and infarction of the brain

Jane Skjøth-Rasmussen

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Official opponents: Gitte Moos Knudsen, Copenhagen, Jens Bjørn Bülow, Copenhagen.

Tutor: Søren Risom Kristensen, Odense.

Correspondence: Jane Skjøth-Rasmussen, Tårnborgvej 7B, 4220 Korsør, Denmark. E-mail: j.skjoeth@dadlnet.dk

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ABSTRACT

Aneurysmal subarachnoid hemorrhage (SAH) is a disease with a high morbidity and mortality. Ischaemia of the brain arises from the initial bleeding and later cerebral vasospasm may narrow the blood vessel depriving the brain of its oxygen and glucose supply to such an extent that deficits arise. At a certain point between the onset of ischaemia and the resulting brain infarction, the ischaemia manifests itself clinically (DIND), but prior to that, alterations in cerebral metabolism may be observed.

The primary aim of this dissertation has been to make a clinical evaluation of microdialysis as a tool to predict secondary cerebral ischaemia after SAH, to evaluate microdialysis in relation to development of clinical signs of ischaemia in a group of patients with SAH as compared to cerebral blood flow measurements, and finally, to examine endothelin-1 in selected patients as a probable predictor of cerebral ischaemia.

The main result was identification of a pattern in the cerebral extracellular metabolites that indicated cerebral ischaemia. Of 42 patients with SAH, DIND developed in 18 patients and in 17 an "ischaemic pattern" (i.e. increases in the lactate-pyruvate and lactate-glucose ratios of greater than 20% followed within 24 hours by a greater than 20% increase in the glycerol concentration) was identified. The pattern predicted the subsequent DIND with a sensitivity of 94% and a mean warning period of 11 hours, and a subsequent infarction could be predicted with a 90% sensitivity. In 13 patients monitored during aneurysm surgery, the aforementioned "ischaemic pattern" was found in all patients in whom temporary occlusion was used or if infarction occurred during surgery, but in no one with an uneventful intervention. In all the patients monitored with microdialysis the glycerol concentration tended to be increased in case of infarction, but was not discriminative to cerebral ischaemia without development of infarction.

In 19 patients the cerebral blood flow (CBF) was measured and correlated to clinical deficits as compared to measurements of cerebral metabolites sampled by microdialysis. We found no correlation between CBF and cerebral metabolites, but that the cerebral metabolites associated much better to DIND than CBF.

Finally, the levels of endothelin-1 (ET-1) were measured in a selected group of patients. We did not find any association between concentrations of ET-1 and the occurrence of DIND. Overall the ET-1 concentration was increased initially, decreased gradually during the following days and did not differ significantly from reference values. ET-1 was of no value as predictor of ischaemia.

In conclusion it was found that by using microdialysis sampling to analyze for glucose, pyruvate, lactate and glycerol, DIND was predicted in 94 per cent of the patients in advance of clinical symptoms, that an "ischaemic pattern" was a consistent finding in cerebral ischaemia but that the level of individual parameters could not discriminate whether the patient sustained infarction or not.