Cerebral microdialysis

The principle of cerebral microdialysis is to mimic a capillary blood vessel in the brain for the assessment of local cerebral metabolism.

Compounds assayed include: lactate, pyruvate, lactate/pyruvate ratio, glucose, glutamate, urea and electrolytes including K+ & calcium. Some observational data:

1. lactate levels increase during episodes of SjVO2 desaturation

2. decreased extracellular glucose was associated with increased mortality

Indications

Bedside microdialysis for detection of early brain injury after out-of-hospital cardiac arrest [1].

Cerebral microdialysis is a widely used clinical tool for monitoring extracellular concentrations of selected metabolites after brain injury and to guide neurocritical care [2].

Extracellular glucose levels and lactate/pyruvate ratios have high diagnostic value because they can detect hypoglycemia and deficits in oxidative metabolism, respectively. In addition, patterns of metabolite concentrations can distinguish between ischemia and mitochondrial dysfunction, and are helpful to choose and evaluate therapy.

The interstitial space of biological tissues and fluids is sampled through a thin fenestrated dialysis catheter inserted into the brain.

Clinical neurochemical monitoring of glucose and lactate levels in the extracellular space of the cerebral cortex is technically feasible and provides insight into the bioenergetic status of the brain. Increased lactate and decreased glucose, indicating accelerated glycolysis, commonly occurred with cerebral ischemia or hypoxia, and increased anaerobic glycolysis in this setting is associated with a poor outcome [3].

Intracerebral microdialysis with bedside analysis and display of chemical variables related to cerebral energy metabolism, excitotoxicity, and cell membrane degradation has been available as a clinical routine technique since 2000s [4] [5] [6].

As the microdialysis probe reflects the biochemistry from a very narrow zone surrounding the dialysis membrane, appropriate positioning and documentation of the position of the catheter in relation to focal lesions is necessary for a correct interpretation of the data obtained [7].

Intracerebral microdialysis revealed mitochondrial dysfunction by marked increases in cerebral

lactate and lactate/pyruvate ratio simultaneously with normal levels of pyruvate and a normal PbtO(2). This metabolic pattern is distinctively different from cerebral ischemia, which is characterized by simultaneous decreases in PbtO(2) and intracerebral pyruvate [8)]

Cerebral online microdialysis monitoring may detect the metabolic changes in the extracellular fluid associated with ischemia.

In 60 patients a microdialysis catheter was inserted into the brain parenchyma that is most likely to be affected by vasospasm directly after aneurysm clipping. Hourly analyses of glucose, pyruvate, lactate, and glutamate levels were performed using a bedside device. Blood-flow velocities were obtained using serial TCD measurements. Cerebral angiography was routinely performed on Day 7 after aneurysm clipping or earlier in cases of clinical deterioration (30 patients). In all patients the results of microdialysis monitoring, TCD ultrasonography, and angiography were correlated. The mean duration of monitoring was 7.3+/-2.5 days. In patients with acute ischemic neurological deficits (18 patients) immediate microdialysis-recorded alterations were observed if the probe was placed close to the malperfused region. In 13 of 15 patients with symptomatic vasospasm (delayed ischemic neurological deficit [DIND]), the microdialysis-recorded values revealed secondary deterioration. In terms of confirming DIND, microdialysis had the highest specificity (0.89, 95% confidence interval [CI] 0.78-1) compared with TCD ultrasonography (0.63, 95% CI 0.46-0.8) and angiography (0.53, 95% CI 0.35-0.7). For microdialysis, the positive likelihood ratio was 7.8, whereas this was significantly lower for TCD ultrasonography (1.7) and angiography (2.1).

Although angiography also demonstrates vessel narrowing in asymptomatic patients, online microdialysis reveals characteristic metabolic changes that occur during vasospasm. Thus, online microdialysis may be used to confirm the diagnosis of vasospasm [9)].

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