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Comparison of recovery and delivery in vitro for calibration of microdialysis probes

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Abstract

One approach to calibrating a microdialysis probe in vivo is to determine the amount of a test compound that diffuses out of the membrane relative to the amount in the perfusate (i.e., the probes delivery) and assume that the same relation exists for the amount of analyte that will diffuse into the probe relative to the concentration in the sample (i.e., the probes recovery). This concept was systematically tested in vitro with a wide range of compounds, microdialysis probe configurations, dialysis membrane types, and solution conditions. Recovery was found to depend on the identity of the analyte, the type of dialysis membrane, the membrane length, the perfusion flow rate, and the perfusate pH. Recovery was independent of the analyte concentration. No statistically significant difference was found between the recovery and delivery of a given compound with a given probe under any of the conditions tested.

Keywords: Microdialysis sampling; Membranes; Calibration

1. Introduction

Microdialysis sampling has become an important technique for studying neurochemical release in the brain [1] and is gaining acceptance in sampling from peripheral tissues [2–6]. Microdialysis sampling is accomplished by implanting a short length of hollow fiber dialysis membrane at the site of interest. This fiber is slowly perfused with a sampling solution. If a concentration difference exists between the probe lumen and the surrounding tissue small molecules will diffuse in or out of the microdialysis probe. If the concentration of the compound is higher in the tissue than in the perfusate, net mass transport will be into the probe. This is termed a recovery experiment. On the other hand, if the concentration is higher in the perfusate than in the surrounding tissue net mass transport will be out of the probe. This is termed a delivery experiment.

The perfusate flow rate, although typically in the range of 1 to 5 μl/min, is typically too fast for equilibration to occur between the perfusate and surrounding tissue. Rather the concentration determined in the dialysate is some fraction of the actual tissue concentration. The ratio of the dialysate concentration to the tissue concentration is termed the recovery of the microdialysis probe and is the calibration factor needed for quantitative microdialysis sampling. While the recovery of a microdialysis probe can readily be determined in vitro using samples of known concentration, it is not possible to

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