Paper VII

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Membrane Dynamics of an Implantable Osmotic Glucose Sensor

Olga Krushinitskaya, MSc; Tor Inge Tønnessen, MD; Henrik JakobsenMSc; Erik Johannessen, PhD

Vestfold University College
Tønsberg, Norway
Olga.Krushinitskaya@hive.no

Objective:
Nanoporous membranes with selectivity at the molecular level are a prerogative for a functioning osmotic glucose sensor. As well as offering immunological protection and retention of the concanavalin A (ConA)–dextran affinity assay components, a rapid confluence of glucose is required in order to realize a successful sensor. In this study, the transmembrane dynamics of different membrane candidates have been assessed in order to identify the most successful sensor configuration.

Method:
A laboratory model based on albumin (65 kDa) of comparable size to ConA–dextran and glucose (180 Da) were used to investigate the dynamics of several nanoporous membranes with pores offering a molecular weight cutoff (MWCO) ranging from 500 Da to 500 kDa during a 12 h experimental timeframe.

Results:
In the test with the membranes offering a MWCO of 500 Da and 500 kDa the osmotic pressure (from 78–37 mBar) was used to indicate the confluence of albumin. The higher pressure suggested a better retention rate, which slowly decreased with increasing pore size. The fouling effects from albumin were negligible, and the corresponding response time of the glucose ranged from 2.5 h down to 2 min.

Conclusion:
It was found that membranes based on anodic aluminum oxide with a pore size of 4–6 nm (approximately 50 kDa) and 1 μm film thickness represented the best compromise between low assay component leakage and glucose confluence offering a response time of 15 min.