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Zachary Niswonger

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Lawrence, M.B., McIntire, L.V., Eskin, S.G., "Effect of Flow on Polymorphonuclear Leukocyte/Endothelial Cell Adhesion." ***Blood*** **70.5 (1987): 1284-1290.**

This article details an experiment on the adhesion of polymorphonuclear leukocytes, or PMNL to endothelium, or the outer layer of cells on organs. This experiment was different than many before it as it focused on the effect of shear stress caused by fluid flow, whereas most previous experiments had focused on the adhesion of PMNL in more ideal conditions that did not involve fluid flow. Along with this, the rolling velocity of PMNL cells was also tested.

First, the endothelial cells were first harvested, and then seeded and cultured. Next, blood was drawn from healthy male donors and the PMNL cells were extracted then put into suspension. Then, platelet-poor plasma was prepared by centrifuging blood. The experimental apparatus was constructed using two plates, one of which had PMNL cells seeded while the other did not. A syringe pump was used to regulate fluid flow which was used to produce four different shear stress rates similar to those found in veins. The cell adhesion was determined by counting the number of PMNL cells before and after 10 minutes of fluid flow. Not only were tests done at different flow rates, but also with different substances suspected to increase adhesion as well as with the cells attached to nylon instead of endothelial cells.

The results of the experiment showed that doubling the shear stress from about 1 to 2 dynes/cm^3 reduced the adhesion by over a factor of 4, and doubling it again reduced the adhesion to almost 0. The samples that were tested with IL 1, the substance theorized to increase adhesion, was shown to increase adhesion greatly at 2 dynes/cm^3, but by much less at 3. Overall, the results supported that IL 1 increases adhesion. The results also showed that PMNL cells did not adhere to nylon anywhere near as well as to the endothelium. The PMNL cells rolled much faster on nylon however. The rolling velocity also was shown to have a strong correlation with shear force.

In terms of future research, it is suggested that more studies be conducted on the effects of different processes on blood flow in order to obtain more information on the adhesion of PMNL cells in the human body in comparison to ideal lab conditions. The article makes no specific references to funding or supporting organizations.

Lampin, M., Warocquier-Clérout, R., Legris, C., Degrange, M., Sigot-Luizard, M.F. "Correlation between substratum roughness and wettability, cell adhesion, and cell migration." ***Journal of Biomedical Materials Research*** **36.1 (1997): 99-108.**

Previously, studies have been conducted on the effect of numerous factors of biomaterials on cell adhesion, including but not limited to the porosity, surface charge, topography, and wettability of the biomaterial. This article details a study on a new property, the degree of roughness of the PMMA, or polymethyl methacrylate.

First, the PMMA surfaces were prepared. These 1 inch by 1 inch squares were sandblasted by different sizes of sand at different air pressures to generate different topographies, and then a scanning mechanical microscope was used to measure multiple different measures of

the topography, such as lowest peak to peak distance for example. Then, the contact angle was determined by dropping a drop of liquid onto the surface and using a program that determined the angle based on a picture taken as the liquid made contact. Next, cells were seeded onto the PMMA surfaces and allowed to grow, then cell counts were taken. Next, adhesion was tested by having the cells removed using an enzyme, and the levels of detachment were measured. Finally, cell viability was tested, the cells were imaged, silver stained, and examined under microscope.

The results of the study showed that as roughness increased, so did the contact angle, making rougher surfaces more hydrophobic. However, proteins from the seeding and growth of the cells on the PMMA surface adsorbed onto the surface, leading to a massive decrease in contact angle, making the effect of roughness almost negligible. The results also indicated that an increase in roughness led to an increase in migration range of the cells, but not in the number of cells migrating. The imaging taken of the cells showed little difference in phenotype of the cells based on roughness of the PMMA they adhered to. Finally, the results suggested that cellular adhesion was stronger on rougher surfaces compared to smooth surfaces.

The authors suggest that future research focus on the proteins that were deposited onto the PMMA. Specifically, they intend to identify and quantify these proteins deposited onto the surface as a function of surface properties and incubation time. This study gives no specific acknowledgements to any funding sources or overall costs.

Srinivasan, V., Pamula, V.K., Fair, F.B. “Droplet-Based Microfluidic Lab-on-a-Chip for Glucose Detection.” *Analytica Chimica Acta* 507.1 (2004): 145-150.

Previously, diabetes and hypoglycemia needed larger scale testing that was more costly, time consuming, and required larger samples than smaller microfluidic systems. Typical microfluidics systems rely on a constant flow of liquid, whereas using discretized microdroplets, which is what these researchers focused on, makes the chip easier to make, makes it more adaptable, and more scalable.

The chip uses calorimetry to determine the glucose content. It does this by utilizing the reaction of glucose with hydrogen peroxide and glucose oxidase which generates a purple solution that absorbs light at the wavelength of 545 nm. The glucose concentration is then determined using the rate kinetic method, which takes less than a minute compared to the five minutes previous methods took. This is done by using the absorbance readings over time to determine the concentration of the quinoneimine, the substance that causes the purple coloration, using Beer’s Law, which can then be used in conjecture with the rate law for the equation to determine the initial concentration of glucose.

The chip itself consists of an electrowetting system that creates the droplets of fluid, which are sandwiched between two layers of glass, one with electrodes on the bottom and the other with indium tin oxide to form the ground electrode. The chip also has a LED light on one side and a photodiode on the other, which records the intensity of light received. The relationship between the light shone and the light received can be used to determine the absorbance. The experiment itself was conducted by first releasing two droplets of the glucose sample and the

reagent, then these drops mixing in the chip, then absorbance readings were taken over thirty seconds.

The chip was shown to exhibit an excellent linear relationship in accordance with Beer's Law, and was consistent with spectrophotometer readings up to a concentration of 400mg/dl. They contributed the separation of data at this point to a difference in measured rate and initial rate past this point. They then calculated the accurate detection limits which were 9 and 15 mg/dl for dilutions with dilution factors of 2 and 3 respectively. Overall, the new system of detection was found to be as effective as conventional methods.

Future work suggested includes the development of an automatic dispensing system as well as testing using actual human physiological samples in order to determine its functionality in the medical field. The authors acknowledged multiple peers for their assistance but left no acknowledgements for any funding sources and made no reference to overall project cost.