**Biocompatibility of polyurethanes’ thin film on smooth muscle cells**

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**Highlights**

* Viability of SMC was higher in polyurethanes that have greater PCL content.
* Presence of PCL increased the contact angle of polyurethanes.
* Polyurethanes surfaces showed a hydrophilic behavior.

**1. Introduction**

Cardiovascular diseases represent the first cause of death worldwide, due to some vascular pathologies such as atherosclerosis, hypertension, thrombosis, angioplasty and restenosis that occur in blood vessels [1]. It is known that those pathologies are related with some disorders in the wall vessel structure like abnormal proliferation of smooth muscle cells (SMC) due to a phenotype change from contractile to synthetic [1,2], that lead a migration and accumulation from the media into the intima [3].

The use of polyurethanes as synthetic materials has gained a lot of attention on the field of tissue engineering, for their production process, versatility and biocompatibility [4], owned by the presence of a segmented chemistry that allow to adjust the mechanical, physical and biological properties by the adjustment of the raw materials [5].

Once the material is immersed in the cellular environment, the processes of adsorption of proteins on the surface of the material allows cell adhesion [6]. The properties of the material surface such as hydrophobicity and chemical composition are important for the biocompatibility of the material and can allow a better performance of the grafts. Thus, the aim of the investigation was to relate the effect of the composition, in terms of the contact angle of polyurethanes and the biocompatibility of smooth muscle cells.

**2. Methods**

Polyurethanes were synthetized via a two-step polymerization. Polycaprolactone, polyethylene glycol, isophorone diisocyanate and pentaerythritol (crosslinker) were used. Each polyol sample was diluted in 10 mL of DMF at 110 °C, and then IPDI was added at an NCO/OH ratio of 1 and allowed to react for 15 min at 70 °C. PE was added to the prepolymer [7]. Thin films of 150 µm were prepared and cured at 110 °C for 12 h.

Sessile drop method was used to measure contact angle in a MobileDrop (KRÜSS GmbH, Hamburg, Germany) with distilled water at room temperature.

Aortic smooth muscle cells (AoSMCs, Walkersville, Maryland) were cultured and used at passage 6-7. Cell suspension with a density of 1x106 cell/mL were cultured for 12 h. Polyurethane samples were placed with cells for 24 h (5% CO2 at 37 °C). After, samples were removed and 100 µL of resazurin solution (44 µM) was added and incubated for 4 h. The fluorescent product resorufin was measured with at a wavelength of 590 nm using an excitation wavelength of 560 nm.

**3. Results and discussion**

Figure 1A shows the results for viability test of SMC in polyurethanes. As it can be seen the viability was higher in polyurethanes that have greater PCL content. PCL is a widely used polymer for biomedical applications as their high biocompatibility [8].

The contact angle values of the surface of PUs are presented in Figure 1B. Contact angels over 90° represent a hydrophobic surface, thereby polyurethanes surfaces showed a hydrophilic behavior, that can be explain by the hydrophilic nature of PEG. The presence of PCL increased the contact angel due to its hydrophobic character [7].

b

a

**Figure 1.** Aortic Smooth Muscle cell viability on polyurethanes (a); Contact angle of polyurethanes surface (b). Polyurethane composition is express as PEG/PCL/PE. Mean (n = 3) ± standard deviation; According to the analyses of variances and Tukey Pairwise Comparisons, means that do not share a letter are significantly different (p < 0.05).

**4. Conclusions**

For AoSMC hydrophobic surfaces allow a better environment for cells. The composition of the material is important for hydrophilicity possibly due to the nature of the polyols (PEG and PCL, hydrophilic and hydrophobic polyols, respectively), which will determine the behavior of the material and subsequently its biocompatibility with smooth muscle cells.

**References**

1. F. Wolf, F. Vogt, T. Schmitz-Rode, S. Jockenhoevel, P. Mela, Drug Discov. Today. 21:9 (2016) 1446–1455.
2. P.H. Blit, K.G. Battiston, M. Yang, J.P. Santerre, K.A. Woodhouse, Acta Biomater. 8:7 (2012) 2493–2503.
3. H. Chen, G.S. J. Kassab, Biomech. 49:12 (2016) 2548–2559.
4. F. Montini-ballarin, D. Calvo, P.C. Caracciolo, F. Rojo, P.M. Frontini, G.A.J. Abraham, Mech. Behav. Biomed. Mater. 60 (2016) 220–233.
5. H.-Y. Mi, X. Jing, B.S. Hagerty, G. Chen, A. Huang, L.-S. Turng, Mater. Des. 127 (2017) 106–114.
6. H.-I. Chang, Y. Wang, in: Regenerative Medicine and Tissue Engineering - Cells and Biomaterials, 2012, pp. 569–588.
7. S. Arévalo-Alquichire, M. Morales-Gonzalez, L. Diaz, M. Valero, Molecules. 23:8 (2018) 1942.
8. J. Horakova, P. Mikes, A. Saman, V. Jencova, A. Klapstova, T. Svarcova, M. Ackermann, V. Novotny, T. Suchy, D. Lukas, Mater. Sci. Eng. C. 92 (2018) 132–142.