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Investigation of the *in vivo* behavior of membranes made of electrospun micro- and nanofibers implanted on an animal model

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Electrospinning of micro and nanofibers is used in biology and medicine to create dressings, scaffolds for tissue engineering or e.g. prostheses. Both polymers of natural and artificial origin may be electrospun. The use of synthetic polymers enables the creation of materials with a custom-made structure, which does not contain animal-derived pathogens and has a long storage time. The use of natural polymers allows primarily to obtain much higher biocompatibility of the created materials. We present the results of the research, aimed to determine how biocompatible electrospun materials behaved in vivo while implanted on an animal model – rodent. Membranes made of anti-adhesive protein retained its properties, which may be used to produce anti-adhesive dressings. The membranes made of synthetic polymer did not inhibit the formation of blood vessels and could find its use in urology. The properties of the membrane surface had the greatest impact on the absorption of membranes from electrospun micro and nanofibers of the synthetic polymers while for natural polymers properties of their native form are more important.

We carried out studies on the in vivo behavior of membranes made of electrospun micro and nanofibers from synthetic polymer (poly (L-lactide-co-caprolactone), PLC) and natural polymer (Human Plasma Albumin, HSA). Depending on the type of material and surface properties (hydrophilic or hydrophobic), we obtained different results of tissue and material interaction – from encapsulation of the material showing lack of tissue integration and very difficult

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later resorption of the material, through tissue separating material that prevents abnormal scar formation, but which is later easily absorbed; up to a perfectly biocompatible material that works well with the tissue, was overgrown by the blood vessels and is resorbable.

For the electrospun synthetic polymer, we found the strongest relationship between the properties of the surface of the material and the possibility of resorption. In an *in vivo* study on an animal model; when used as a ureter implant, the material very well isolated tissues from the toxicity of urine. The introduction of the hydrophobic properties of the material surface did not degrade the functionality of the implant. It still worked well with the tissue and fulfilled the expected functions. For an implant made of an electrospun synthetic polymer with a hydrophobic surface, we found material encapsulation and complete lack of tissue integration while maintaining functionality. For material with significantly less hydrophobic surface properties, the implant fulfilled its role perfectly but also integrated with the tissue, which in facilitated the possibility of resorption and the creation of functional tissue.

Implantation of electrospun synthetic polymers, both intraperitoneal and intradermal, showed gradual integration of the material with the tissue and overgrowth by blood vessels, which should facilitate further resorption of the material.

Our earlier in vivo results in an animal model – a rat in the neurological use of electrospun membranes; showed a reduction in scarring and the formation of a more structured scar for electrospun synthetic polymer (PLC) use. We obtained similar results by membranes made of electrospun natural polymer – Human Serum Albumin (HSA) which inhibits the attachment and growth of cells. The created material prevented fusion of tissues showing strong anti-adhesion properties. These properties were not due to the hydrophobicity of the surface – the created material had strong hydrophilic properties nor were they caused by the non-absorbability of the material used. We have shown that the specific anti-adhesion properties of the polymer in its natural form had the greatest impact on the properties obtained, we also showed that the material was rapidly absorbed and outgrew by the blood vessels after exceeding the period of inhibition when it played the of the anti-adhesion function.

In our research, we have shown that in the in vivo biocompatibility of electrospun synthetic polymers, surface modification plays a greater role, while in the case of natural polymers - the properties of their native form are more important.

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