

Summary of doctoral dissertation on:

**„ The use of nuclear magnetic resonance in the detection of Trastuzumab binding to breast cancer cells”**

Mgr inż. Zuzanna Bober

Promoter: dr hab. n. med. inż. Dorota Bartusik-Aebisher, Profesor UR

Magnetic resonance imaging (MRI) is one of the most popular methods of modern diagnostics. Continuous development of the method enables ever newer areas of application. Using MRI, we can not only visualize, but also track pharmaceutical substances and labeled cells in both *in vivo* and *in vitro* studies. The aim of this study is to present the use of the magnetic resonance method to track cells and modification of the drug Trastuzumab using  $^1\text{H}$  MRI.

Using the magnetic resonance imaging method, we evaluated the changes caused by Trastuzumab therapy in 2D and 3D cell cultures based on the assessment of longitudinal ( $T_1$ ) and transverse ( $T_2$ ) relaxation times. Monolayer cell cultures of breast cancer cell lines MCF-7 and CRL-2314 and breast cell line HTB-125 were prepared. In addition, we prepared 3D cell cultures in a bioreactor for the CRL-2314 and HTB-125 lines. We added Trastuzumab-dendrimer-fluorine compound to the selected cell cultures. A 1.5 Tesla Optima MR360 clinical MRI (General Electric Healthcare, USA) was used in the study. The therapeutic effect induced by the drug Trastuzumab was evaluated by direct measurements of  $T_1$  and  $T_2$  relaxation times.

Direct measurement of  $T_1$  and  $T_2$  relaxation times by MRI can be implemented to monitor applied therapies in cell cultures. The prepared Trastuzumab derivative Sulfo-LC-SPDP contains molecules with a smaller mass than the drug Trastuzumab, so we can achieve improved efficacy. In addition, the presence of  $^{19}\text{F}$  nuclei allows it to be tracked by MRI measurements. The use of the potential of the MRI method makes it an excellent tool for imaging the morphology of the objects under study as well as allowing us to record changes at the level of metabolism.

Studies have shown the potential of using the MRI imaging method to monitor therapeutic effects and track drugs *in vitro*, and further research could help move this research into initial clinical trials. The applied MRI methods for cell culture enabled the detection of the drug Trastuzumab and its modifications in cell cultures and proved to be a useful diagnostic tool for monitoring applied therapies.