Differential Effect of Non-Thermal Atmospheric-Pressure Plasma on Angiogenesis

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The formation of new blood vessels is an essential feature of tissue remodeling as observed in e.g. wound healing or solid tumor development. For improving wound healing it should be promoted, whereas in treating tumors angiogenesis should be inhibited. Therefore, it is very important to know whether and how plasma influences angiogenesis.

This study focused on the effects of plasma generated by the kINPen 09 on angiogenesis using two different models: HET-CAM assay and rat aortic ring (AOR) test. In both models kINPen 09 treated medium (30 to 300s) was applied. ImageJ was used to analyze vessel area and fractal dimension after treating the CAM from embryonic day 11 to 13. Aortic rings were prepared from either LEW.1W or WOK.W rats. They were embedded in matrigel and treated daily for 4 days starting at day 4 after embedding. We developed a semi quantitative method to quantify production of microvessels from aortic rings.

In both models natural and spontaneous vessel formation was detected. In the HET-CAM assay vessel area and fractal dimension were significantly enhanced at embryonic day 14 by the 120s-plasma treated medium compared to untreated controls. There was no effect of plasma (60 or 120s) on vessel growth of aortic rings prepared from LEW.1W rats. The angiogenic activity of rings from WOK.W rats was significantly ($p<0.05$) inhibited by plasma (120s). Dexamethason was able to completely inhibit vessel sprouting from aortic rings of both rat strains.

In conclusion, the angiogenic response to plasma was found to be differentially influenced. It depended not only on the model used (HET-CEM vs. AOR) but also on the rat strain in the aortic ring test (LEW.1W vs. WOK.W). It will now be of importance to define the different molecular events during the angiogenic response to make plasma applicable for the different demands.

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* Work supported by the German Federal Ministry of Education and Research within the joint research project “Campus PlasmaMed” (grant no. 13N11182)