Differential Sensitivity of Lymphocyte Subpopulations to surface DBD plasma

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Non-thermal atmospheric-pressure plasmas can be used for several applications in medicine. Plasma treatment can be applied to living tissues and cells, e.g. to induce apoptosis and growth arrest in tumour cells or to improve wound healing. However, detailed investigations of plasma-cell interactions are strongly needed. It is not yet clear whether plasmas will be useful in stimulating immune cells to change their behaviour or function. Therefore, it is still in question as to whether plasma can influence mononuclear cells (MNC) to become more sensitive against tumour cells or to generate regulatory cells important in autoimmune diseases.

This study focused on the influence of non-thermal atmospheric pressure plasma on cell surface molecules of rat spleen mononuclear cells (MNC) as one important step to gain insight into plasma-immune cells interactions. Such findings might lead to plasma applications in immunology or cancer treatment. Rat MNC isolated from the spleen were treated for 10 to 60s with plasma by surface dielectric barrier discharge (DBD) at atmospheric pressure in air or argon. Lymphocyte subpopulations and expression of L-selectin, ICAM-1 and LFA-1α expression on T-cells were analyzed by flow cytometry 1 to 48 h after plasma treatment. Further, apoptosis was analysed by annexin V and propidium iodide (PI) staining.

MNC are very sensitive to DBD/air plasma. 24h after a 60s treatment cycle all MNC were dead as shown by the annexin V/PI staining. Already 1 h after a 20s DBD/air treatment about 10% of early apoptotic MNC were detected. Plasma changed the ratio of T- and B-cells in favour of B-cells. Of the T-cells the helper T-cells were reduced while cytotoxic T-cells were less affected. L-selectin expressing T-cells were significantly reduced already 1 h after plasma treatment and that of ICAM-1$_+$ and LFA-1α$_+$T-cells only after 4 h. These effects were time dependent and less dramatic when using DBD/argon plasma.

In conclusion, different lymphocyte subpopulations are selectively sensitive to the effects of plasma. The effects are dependent on the duration of treatment as well as on the time after plasma treatment. By treating MNC with plasma, adhesion between cells can change, thus affecting cellular functions such as migration and proliferation. Due to the reduction of Lselectin, homing of lymphocytes can also be altered. On the other hand, the threshold for activation of MNC is possibly reduced by plasma treatment due to an increase in LFA-1α. Whether these changes can be used to generate regulatory T-cells, to sensitize immune cells against tumour cells or to modify homing of lymphocytes remains to be clarified.

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