

MOTIVATION



After 4.5 months of plasma therapy (3 courses, 12*3 sessions)

Dramatic healing has been shown in non-thermal plasma treatment of diabetic ulcerative wounds.

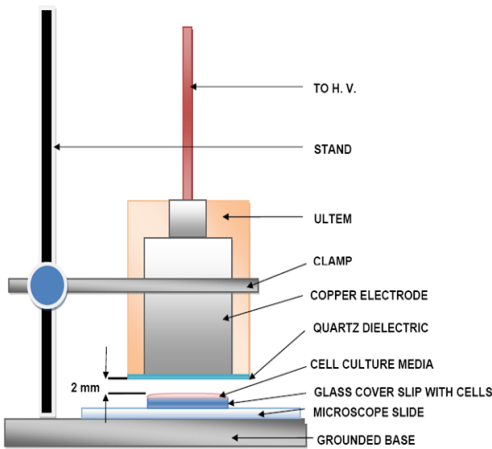
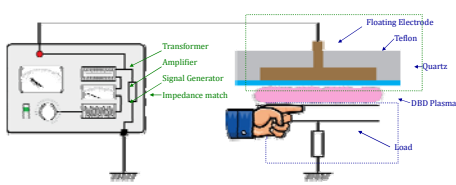
We hypothesize that plasma treatment may induce healing by promoting angiogenesis.

Angiogenesis is the growth of new blood vessels from existing vessels. Angiogenesis is critical to wound healing.

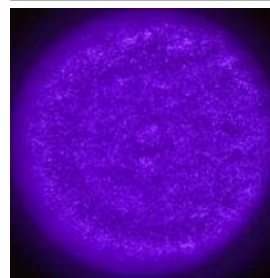
Endothelial cells, which line all blood contacting surfaces in the body, play a guiding role in angiogenesis.

Growth factors such as fibroblast growth factor-2 (FGF-2) stimulate angiogenesis.

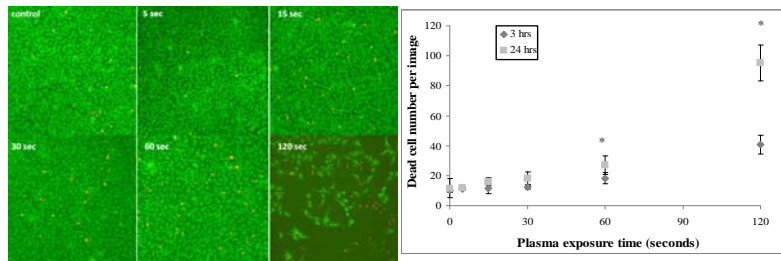
Floating Electrode DBD



Voltage: 20 kV
 Frequency: 0.7 – 2 kHz
 Rise time: ~5 V / nsec
 Pulse duration: ~2 μsec
 Power density: 0.2 – 0.5 W/cm²
 Filament temperature: 320-420K

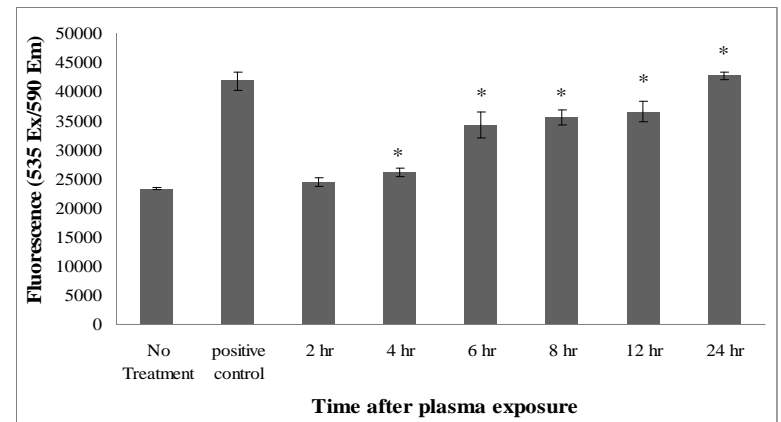


LIVE/DEAD VIABILITY/CYTOTOXICITY ASSAY



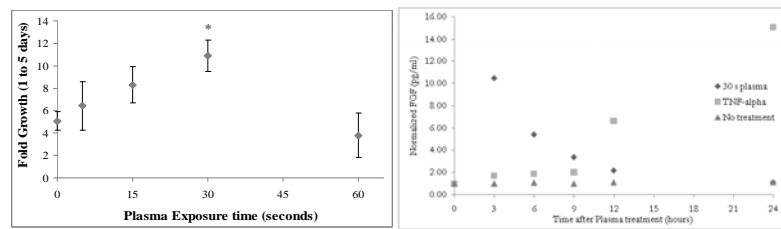
Endothelial cell death increased with plasma exposure time, as measured by Live/Dead assay. Fluorescent images, and quantization of five areas of each sample. * p < 0.01 as compared to control (0 s).

ENDOTHELIAL CELL MEMBRANE DAMAGE



Endothelial cell LDH release increases up to 24 hours post plasma exposure. * p < 0.01 as compared to untreated cells

PROLIFERATION ASSAY



Endothelial cell fold growth is enhanced in 30 s low power non-thermal plasma treated cells 5 days after treatment. * p < 0.01 as compared to control.

30 s low power (0.2 W/cm²) non-thermal Plasma treatment induces FGF-2 release from endothelial cells, peaking at 3 hours post treatment

CONCLUSIONS AND FUTURE WORK

Non-thermal plasma is relatively non-toxic to endothelial cells at short exposure times.

Cell proliferation is enhanced following plasma treatment, which may be related to FGF-2 release.

Additional experiments are needed to relate cell proliferation to FGF-2 release.

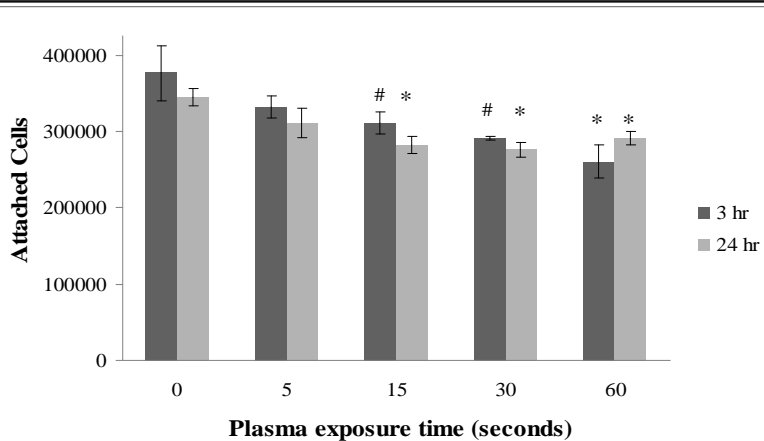
Low power plasma treatment shows promise for novel therapies focused on promotion or inhibition of endothelial cell mediated angiogenesis.

In the future this research will also clarify the effect of non-thermal plasma on the vasculature, which is exposed during plasma treatment of many tissues.

REFERENCES

Fridman, G., et al., *Plasma Chemistry and Plasma Processing* 2006. 26: p 425-442
 Kalghatgi, S., et al, *IEEE Trans. Plasma Sci.* 2007 35(5): p 1559-1566.
 Fridman, G., et. al, *Plasma Chemistry and Plasma Processing*, 27(2): p163-176.

ATTACHED CELLS VS PLASMA TREATMENT



The number of live, attached cells decreases as plasma exposure time increases up to 60 s (p < 0.01 by ANOVA) at 3 and 24 hours post-exposure. * p < 0.01 as compared to 0 s treated control. # p < 0.05 as compared to 0 s treated control