Ultra-weak photon emission from cancer and non-cancer cells stressed by culture medium change and TNF-α: dose dependent oscillations

Pierre Madl[1,4*], Thomas Verwanger[1], Mark Geppert[1], Felix Scholkmann[2,3]

[1] Department of Molecular Biology, University of Salzburg, A-5020 Salzburg, Austria
[2] Biomedical Optics Research Laboratory, Department of Neonatology, University Hospital Zurich, CH-8091 Zurich, Switzerland
[3] Research Office for Complex Physical and Biological Systems, CH-8038 Zurich, Switzerland
[4] EDGE-Institute at ERSystem, A-5440 Scheffau/Tennengebirge, Austria

How is the spontaneous photon emission of cell affected by a cell culture medium change and/or the application of the pro-inflammatory cytokine tumor necrosis factor alpha (TNF-α)? This study investigated this questions.

Introduction

- Cells spontaneously emit photons in the UV to visible/near-infrared range (**ultra-weak photon emission, UPE**).
- Perturbations of the cells' state cause changes in UPE (**evoked UPE**).
- **Aim** of the present study: analyze the **evoked UPE dynamics** of cells caused by two types of cell perturbations (stressors):
  - a cell **culture medium change**, and
  - application of the pro-inflammatory cytokine tumor necrosis factor alpha (**TNF-α**).

Material and Methods

- Four types of human cell lines were used: (1) squamous cell carcinoma cells, **A431**; (2) adenocarcinomic alveolar basal epithelial cells, **A549**; (3) p53-deficient keratinocytes, **HaCaT**, and (4) cervical cancer cells, **HeLa**.
- In addition to the medium change, **TNF-α** was applied at different concentrations (5, 10, 20, and 40 ng/mL) and UPE measurements were performed after incubation times of 0, 30, 60, 90 min, 2, 5, 12, 24, 48 h.

Results, Discussion & Conclusions

- It was observed that:
  - The change of cell culture medium (without added TNF-α) induces a **cell type-specific transient increase in UPE** with the largest UPE increase observed in A549 cells.
  - The addition of **TNF-α induces a cell type-specific and dose-dependent change in UPE.**
  - Stressed cell cultures in general exhibit **oscillatory UPE changes**.

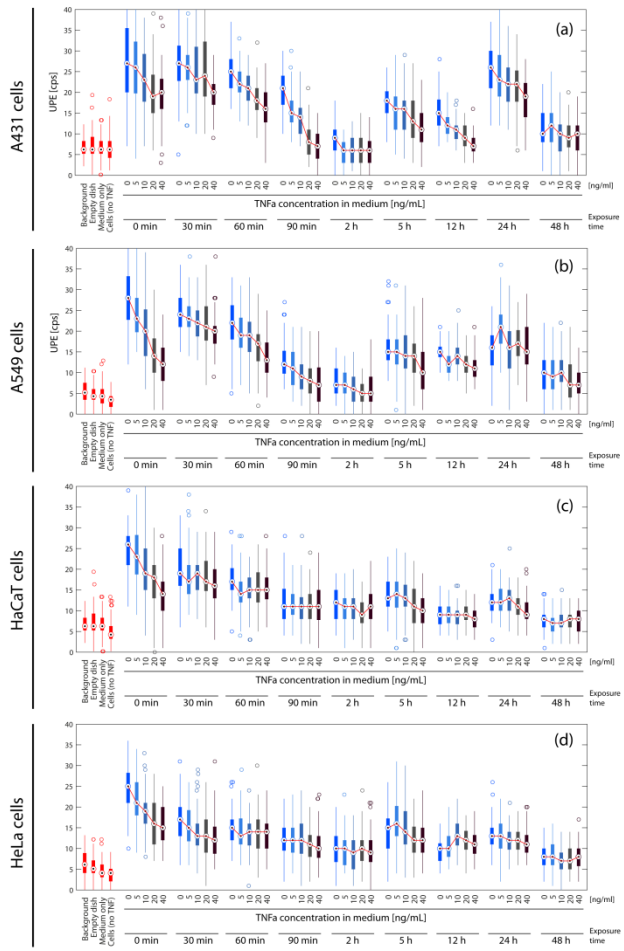

Figure 3: Time-series of UPE measurements of the four cell-lines used. The four initial readings in each graph relate to the background measurement batch (including cells not exposed to TNF-α). Subsequent readings relate to cells exposed to fresh medium (fresh medium change was made only at interval "0 min" along with the corresponding TNF-α concentrations).

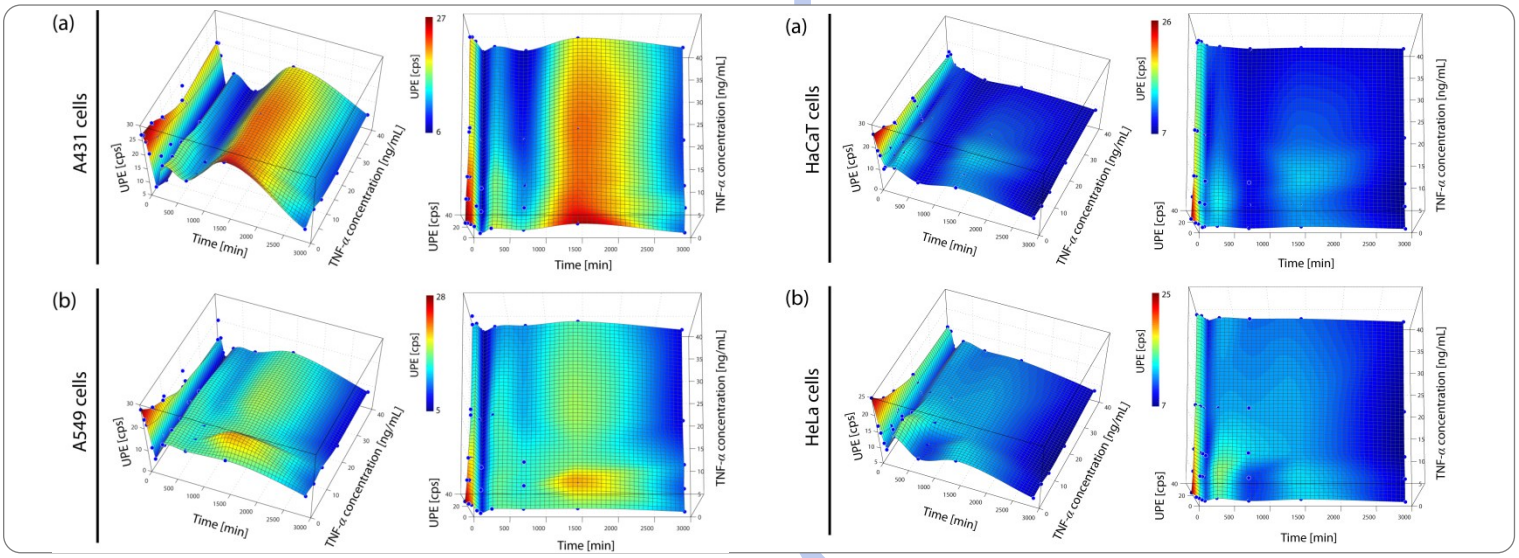

Figure 1: Non-monotonic time-dependent UPE behaviour of (a) A431 and (b) A549 cells. The magnitude of the oscillation reflects both stimulus and cell type dependency.

Figure 2: Non-monotonic time-dependent UPE behaviour of (a) HaCaT and (b) HeLa cells. The magnitude of the oscillation reflects both stimulus and cell type dependency.

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ROCoS Research Office for Complex Physical and Biological Systems Zurich, Switzerland

BORL Biomedical Optics Research Laboratory University Hospital Zurich | Division of Neonatology