Gas plasma effects on chemoresistance ovarian cells

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Interaction of plasma with biological objects

Time scale

- ns-µs
- µs-ms
- ms-min
- s-day

Plasma

After glow

Liquid

Cell/Tissue

A. Plasma Physics
B. Plasma Chemistry
C. Solution Chemistry
D. Biochemistry
CAP as a cocktail of chemical and physical factors

Equivalent total oxidation potential (ETOP) as the definition of plasma dose

1. H is the equivalent total oxidation potential of the RONS

2. T is the equivalent total oxidation potential associated with the reactive agents unrelated to RONS, such as electric field and UV/VUV

3. $f(H, T)$ is the equivalent total oxidation potential related to the synergistic effects between H and T factors
Different configuration of plasma jets
Schematic of the experimental setup
Physical characterization of plasma

The voltage waveform of plasma

Plasma plume temperature measurements at different times

Plasma plume temperature measurements at different distances from nozzle
Optical emission spectroscopy of the plasma jet
Quantitative real-time reverse-transcription polymerase chain reaction (qRT-PCR)

Acridine orange (AO) propidium iodide (PI) staining

H&E staining

MTT Assay

A2780 CP Cancer cells

SKOV-3 Cancer cells

GCS Normal cells
Isolation of granulosa cells

Mice were sacrificed with cervical dislocation. Ovaries were removed and punctured with two needles and then was used collagenase IV as enzymic digestion and after 30 min neutralized with FBS, so granulosa cells were released into media culture (α MEM, 1% antibiotic, 15% FBS). Cells were cultured in α MEM supplemented with 10% FBS and 1% antibiotic at 37°C and 5% CO₂.
Proving the existence of granulosa cells

**Fig. A.** shows morphology of cultured granulosa cells, with H & E staining. **Fig. B.** Flow cytometry analysis for proving the existence of cultured granulosa cells with α-inhibin as a marker of granulosa cells.
Viability of GCs, SKOV-3, and A2780 CP cells treated with CAP

CAP treatment

% Cell Viability

Exposure Time (s)

A2780 CP
GCS
SKOV3

0 20 40 60 80 100 120 140 160 180 240

0 50 100 150
Viability of GCs, SKOV-3, and A2780 CP cells treated with PAM
Viability of GCs, SKOV-3, and A2780 CP cells treated with CAR
Viability of GCs, SKOV-3, and A2780 CP cells treated with PTX

Paclitaxel

% Cell Viability

Concentration (μM)

A 2780 CP
GCS
SKOV-3
Viability of GCs, SKOV-3, and A2780 CP cells treated with CAR, PTX and CAP

![Cell Viability Graph]

**CAR+PTX+CAP**

- **A2780 CP**
- **SKOV3**
- **GCS**

Cell Viability % Normalized to control

- **PAM (60s)**
- **PAM (120s)**

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Extracellular $\text{H}_2\text{O}_2$ in two culture medium

**Graph 1:**
- Concentration vs. Time
- **$\text{H}_2\text{O}_2$**
- **1% FBS**
- **10% FBS**

**Graph 2:**
- Concentration vs. Time
- **$\text{H}_2\text{O}_2$**
- **1% FBS**
- **10% FBS**
Physical factors:
- Electric field and UV radiation
- pH and concentration of
  - $H_2O_2$, $NO_2^-$, and $NO_3^-$

Enhancing Cancer Chemosensitivity

Induces intrinsic Apoptosis

Improve selective effects of CAR and PTX

Selectivity for Cancer Cells

Overcome chemoresistance in ovarian cancer

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Thank you for your attention

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