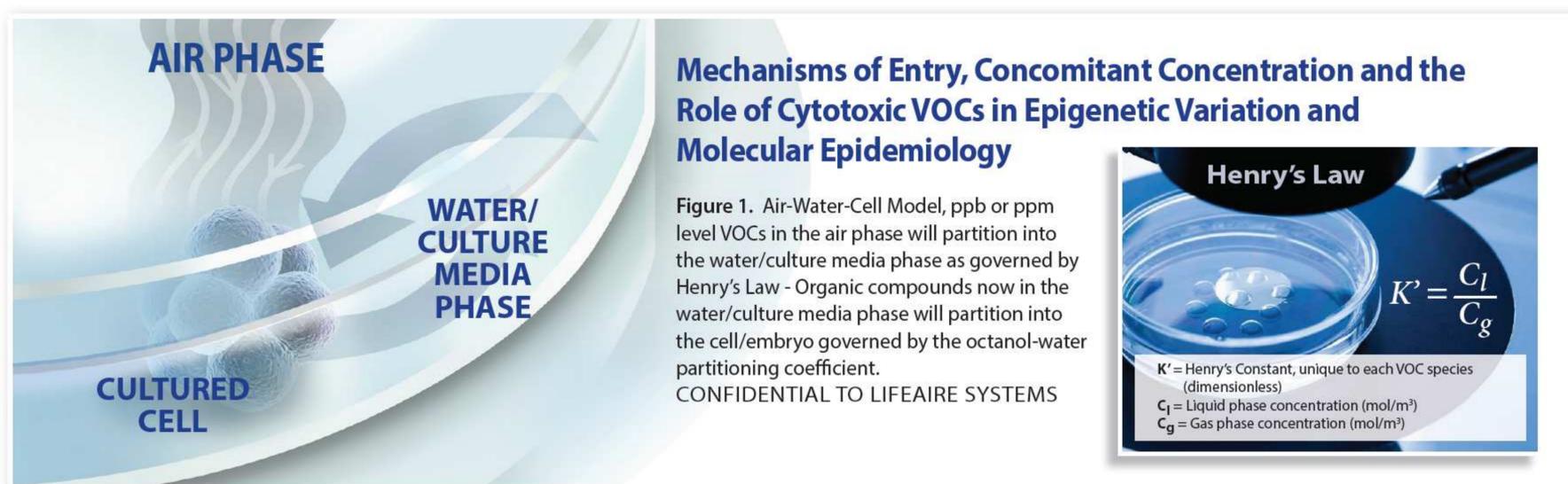


BACKGROUND AND AIMS

VOCs affect embryo development and are critical in preimplantation toxicology and epigenetic processes. This study sought to define the mechanisms of cytotoxicity of VOCs common to IVF laboratories. The VOC concentrations were modeled using Henry's Law (HL) and octanol water partitioning coefficients (OWPC).

METHODS

HL was used to model VOC mass transfer from the air to the water/media phase using the air-water partitioning coefficient and the ratio between the liquid and air phase concentration for each compound. The OWPC was used to correlate the mass transfer from the water/media phase to the embryo using the ratio between the organic and water phase concentration. Evaluation of over 40 IVF laboratories identified the mean total VOC (TVOC) levels and 6 most common VOCs. HL and OWPC calculations determined the VOC concentrations in the culture media, embryo, and time to reach equilibrium for each compound. Research has shown that TVOC concentrations greater than 500 ppb in the media are embryotoxic. Air phase VOC concentrations were compared to the known embryotoxic VOC levels in media to determine if typical VOC levels in IVF laboratories are embryotoxic.



RESULTS

The concentration of each VOC within the embryo (C_{embryo}) was modeled based on the airborne VOC levels measured and compared to their embryotoxic level. Measured levels of acetone, formaldehyde and isopropanol resulted in cytotoxic cellular levels.

Compound	Air (ppb) Common to the IVF Laboratory	Time for Airborne VOC to Reach Equilibrium in Media (min)	Embryotoxic C_{embryo} ($\mu\text{g VOC/kg of embryos}$)	Modeled C_{embryo} ($\mu\text{g VOC/kg of embryos}$) Based on Tested IVF Laboratories Air
Acetone	425	24.1	285	421.8 (toxic)
Acrolein	85	0.2	489	47.1
Formaldehyde	225	2,162.0	1,132	48,992 (toxic)
Isopropanol	510	90.7	15	119.2 (toxic)
Styrene	170	4.1	445,715	5,989.9
Toluene	225	4.2	244,963	1,521.4

CONCLUSION

Airborne VOCs are magnified in concentration as they partition from the air to the media, and into the embryo. Once cellular, VOCs negatively influence blastocyst conversion, implantation, and clinical pregnancy rates. This study related the measured concentration of airborne VOCs to the modeled embryonic concentration. Furthermore, this novel study defines the mechanisms of cytotoxicity of VOCs by defining their partition from the gaseous to aqueous phase, and to the cellular level.

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