How small differences in dissolved oxygen in follicular fluid influence the developmental competence of the mature human oocyte at the molecular and plasmalemmal levels: Lessons from IVM, IVF and ICSI

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The developmental competence of the human oocyte is largely influenced by the physiology and biochemistry of the intrafollicular environment in which it resides during the growth phase and maturation process prior to ovulation, and where its companion granulosa cells proliferate and produce stage-associated proteins, steroids and other bioactive molecules that have intra-and extrafollicular targets. Coincident with progressive follicular differentiation is the activation of important signaling pathways, including those that are oxygen–sensitive or dependent. This presentation will examine whether a developmentally relevant association exists between the level of intrafollicular hypoxia and (i) the fidelity of chromosomal segregation during meiotic maturation (ii) the preovulatory development of fertilization competence, and after fertilization (iii) the normality of cell-cell communication during early
embryogenesis. These studies show the degree of hypoxia actually experienced by granulosa cells and the oocyte in vivo, and by duplicating these conditions an in vitro system that closely approximates intrafollicular biochemistry and physiology, effects of developmental ignificance for oocyte similar to those associated with aneuploidy, fertilization failure and early cleavage arrest in clinical IVF can be reproduced, and in some instances, reversed. This approach offers the possibility of applying high-resolution protein and RNA analytical methodologies to better understand the influence of intrafollicular physiology on the oocyte in the context of positive or negative downstream consequences on the normality early development. Examples of where this approach as revealed new information in this regard will be discussed.