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Follicle-Stimulating Hormone Induces a Gap Junction-Dependent Dynamic Change in [cAMP] and Protein Kinase A in Mammalian Oocytes

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Abstract

The second messenger cyclic adenosine 5′monophosphate (cAMP) has been implicated in controlling meiotic maturation. To date, there have been no direct measurements of cAMP in living mammalian oocytes. Here, we have used the fluorescently labelled cAMP-dependent protein kinase A (PKA), FlCRhR, to monitor cAMP in mouse oocytes. In cumulus-enclosed oocytes, follicle-stimulating hormone (FSH) stimulated an increase in the oocyte [cAMP] that was prevented by using the gap junction inhibitor, carbenoxolone. The FSH-induced increase in oocyte [cAMP] was suppressed in a time-dependent manner by prior exposure to ATP, while epidermal growth factor had no effect on basal or stimulated levels of cAMP. Finally, using confocal microscopy, we show that the regulatory and catalytic subunits of the microinjected PKA are distributed in a punctate manner with a stronger accumulation in the perinuclear region. On an increase in [cAMP], in response to phosphodiesterase inhibition or FSH, the catalytic subunit diffused throughout the cytoplasm and germinal vesicle, while the regulatory subunit remained anchored. These experiments show that increases in cAMP in ovarian somatic cells are communicated via gap junctions to the oocyte, where it can lead to a redistribution of the catalytic subunit of PKA.

Keywords

cAMP; FlCRhR; PKA; ATP; AKAP; oocyte; gap junction; ovary; mouse

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