

Journal of Andrology, Vol. 24, No. 1, January/February 2003
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Implication of Calmodulin-Dependent Phosphodiesterase Type 1 During Bovine Sperm Capacitation

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Phosphodiesterases (PDEs) are enzymes that degrade cyclic nucleotides. The calcium-calmodulin dependent PDE type 1 (PDE 1) and the cyclic adenosine monophosphate (cAMP)-specific PDE type 4 (PDE 4) have been implicated in sperm function. We tested the hypothesis that specific PDEs regulate capacitation of bovine sperm in a manner independent of those that mediate motility. Our objectives were to determine the effects of inhibiting PDE 1 and PDE 4 on capacitation and motility, and to compare these effects to those of heparin, which is necessary for capacitation of bull sperm in vitro. Fresh sperm were supplemented either with 15 µg/mL heparin (positive control) or the PDE inhibitors vinpocetine (specific for PDE 1) and rolipram (specific for PDE 4), and then incubated for 5 hours. At 0, 3, and 5 hours, samples were assayed for capacitation and motility parameters according to the chlortetracycline (CTC) fluorescent pattern B and computer-assisted sperm analysis, respectively. A higher percentage of CTC pattern B sperm relative to heparin controls was observed at 0 and 3 hours when sperm were incubated with vinpocetine. After 5 hours, the percentage of heparin- and vinpocetine-treated sperm showing pattern B did not differ ($P > .05$). Rolipram did not affect CTC patterns ($P > .05$; $n = 4$). Vinpocetine and heparin both reduced the percentage of progressively motile sperm after 3 and 5 hours, but vinpocetine reduced it more than heparin ($P < .05$; $n = 4$). Rolipram transiently increased linearity versus sperm with heparin ($P < .05$; $n = 4$). To further test the hypothesis that PDE 1 inhibition permits capacitation, we conducted in vitro fertilization. Vinpocetine did not support the ability of sperm to penetrate homologous oocytes ($n = 5$). Although cAMP regulation by PDE 1 may occur early during capacitation, downstream events appear to prevent full capacitation from occurring prematurely.

Key words: Vinpocetine, rolipram, cyclic AMP, in vitro fertilization, motility

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