

Journal of Andrology, Vol. 26, No. 6, November/December 2005  
Copyright © [American Society of Andrology](#)  
DOI: 10.2164/jandrol.05053

# A Cyclic Adenosine 3', 5'-Monophosphate Stimulates Phospholipase C $\gamma$ 1-Calcium Signaling via the Activation of Tyrosine Kinase in Boar Spermatozoa

HIROSHI HARAYAMA<sup>\*</sup>, TETSUMA MURASE<sup>†</sup> AND MASASHI MIYAKE<sup>\*</sup>

From the <sup>\*</sup> Graduate School of Science and Technology, Kobe University, Kobe, Japan; and the <sup>†</sup> Faculty of Applied Biological Sciences, Gifu University, Gifu, Japan.

Correspondence to: Dr Hiroshi Harayama, Graduate School of Science and Technology, Kobe University, 1 Rokko-dai, Nada, Kobe 657-8501, Japan (e-mail: harayama{at}kobe-u.ac.jp).

The aim of this study was to reveal a downstream part of the intracellular signaling that is mediated by cyclic adenosine monophosphate (cAMP)-dependent tyrosine kinases, including spleen tyrosine (Y) kinase (SYK), in boar spermatozoa. Ejaculated spermatozoa were incubated with cBiMPS (a cell-permeable cAMP analog; 0.1 mM) at 38.5°C for 180 minutes and then used for Western blot and indirect immunofluorescence. Incubation of spermatozoa with cBiMPS induced tyrosine phosphorylation at the linker region of SYK (which was essential to binding to phospholipase C [PLC] $\gamma$ 1) in the connecting and principal pieces, but the tyrosine phosphorylation was abolished by the addition of H-89 (a protein kinase A [PKA] inhibitor; 0.01-0.1 mM). Moreover, the cAMP-dependent tyrosine phosphorylation was also induced at the key regulatory residue of PLC $\gamma$ 1 in the same segments of spermatozoa, but it was inhibited by the addition of herbimycin A (a tyrosine kinase inhibitor; 5  $\mu$ M). These results suggest that the sperm cAMP-dependent tyrosine kinases, including SYK, are linked to the activation of PLC $\gamma$ 1. Indirect immunofluorescence clearly detected both inositol 1,4,5-trisphosphate (IP<sub>3</sub>) receptor and calreticulin in the connecting piece, indicating the presence of internal calcium store. Cell imaging with fluo-3/AM (a cell-permeable Ca<sup>2+</sup> indicator) showed that incubation of spermatozoa with cBiMPS increased intracellular free calcium in the middle piece, but that it was reduced by the addition of U-73122 (a PLC inhibitor; 0.02 mM). Based on our findings, we conclude that the connecting piece of boar spermatozoa possesses the PLC $\gamma$ 1-IP<sub>3</sub> receptor-calcium signaling that is triggered by cAMP and mediated by PKA and herbimycin A-sensitive tyrosine kinases, including SYK.

Key words: Sperm, cAMP, SYK, PLC, calcium store

## This Article

- ▶ [Full Text](#)
- ▶ [Full Text \(PDF\)](#)
- ▶ [Alert me when this article is cited](#)
- ▶ [Alert me if a correction is posted](#)

## Services

- ▶ [Similar articles in this journal](#)
- ▶ [Similar articles in PubMed](#)
- ▶ [Alert me to new issues of the journal](#)
- ▶ [Download to citation manager](#)

## Citing Articles

- ▶ [Citing Articles via HighWire](#)
- ▶ [Citing Articles via Google Scholar](#)

## Google Scholar

- ▶ [Articles by Harayama, H.](#)
- ▶ [Articles by Miyake, M.](#)
- ▶ [Search for Related Content](#)

## PubMed

- ▶ [PubMed Citation](#)
- ▶ [Articles by Harayama, H.](#)
- ▶ [Articles by Miyake, M.](#)

This article has been cited by other articles:



**JBC Online**

[▶ HOME](#)

A. M. F. Liu, R. K. H. Lo, C. S. S. Wong, C. Morris, H. Wise, and Y. H. Wong

Activation of STAT3 by G $\alpha$ 's Distinctively Requires Protein Kinase A, JNK, and Phosphatidylinositol 3-Kinase

J. Biol. Chem., November 24, 2006; 281(47): 35812 - 35825.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

---

[HOME](#) [HELP](#) [FEEDBACK](#) [SUBSCRIPTIONS](#) [ARCHIVE](#) [SEARCH](#) [TABLE OF CONTENTS](#)

[Copyright © 2005 by The American Society of Andrology.](#)