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Infertility of CD9-Deficient Mouse Eggs Is Reversed by Mouse CD9, Human CD9, or Mouse CD81; Polyadenylated mRNA Injection Developed for Molecular Analysis of Sperm–Egg Fusion

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Abstract

CD9 is a membrane protein belonging to the tetraspanin family. Despite CD9's broad tissue distribution, the only abnormality observed in CD9-deficient mice was infertility of females, which was responsible for a defect in the sperm–egg fusion process. However, the function of CD9 in sperm–egg fusion is not clear at all because the technique to analyze the activity of molecules in sperm–egg fusion has not been established. We demonstrated that the exogenous mouse CD9, expressed by polyadenylated mRNA injection at the germinal-vesicle stage oocytes, was precisely localized to the egg plasma membrane, and the expression reversed the infertility of CD9^{−/−} eggs. Then, two other tetraspanins, human CD9 and mouse CD81, overexpressed with this technique on CD9^{−/−} eggs restored the fertilization rate up to ~90 and ~50% against that of wild type eggs, respectively. Moreover, in the presence of an anti-mouse CD9 mAb, which blocks sperm–egg fusion, expression of human CD9 or mouse CD81 on eggs also rescued the fusibility. These results suggested that human CD9 plays a crucial role in human fertilization, and mouse CD81 has the potential to compensate for CD9 function in sperm–egg fusion. In addition, the polyadenylated mRNA injection is effective for molecular analysis of sperm–egg fusion.

Keywords

fertilization; sperm–egg fusion; polyadenylated mRNA injection; CD9; CD81

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References

REFERENCES

- 1 T. Aida, S. Oda, T. Awaji, K. Yoshida, S. Miyazaki
Expression of a green fluorescent protein variant in mouse oocytes by injection of RNA with an added long poly(A) tail
Mol. Hum. Reprod., 7 (2001), pp. 1039-1046
- 2 E.A.C. Almeida, A.-P.J. Huovila, A.E. Sutherland, L.E. Stephens, P.G. Calarco, L.M. Shaw, A.M. Mercurio, A. Sonnenberg, P. Primakoff, D.G. Myles, J.M. White
Mouse egg integrin alpha 6 beta 1 functions as a sperm receptor
Cell, 81 (1995), pp. 1095-1104

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- 3 C. Boucheix, E. Rubinstein
Tetraspanins
Cell Mol. Life Sci., 58 (2001), pp. 1189-1205
- 4 M.S. Chen, K.S. Tung, S.A. Coonrod, Y. Takahashi, D. Bigler, A. Chang, Y. Yamashita, P.W. Kincade, J.C. Herr, J.M. White
Role of the integrin-associated protein CD9 in binding between sperm ADAM 2 and the egg integrin alpha6beta1: Implications for murine fertilization
Proc. Natl. Acad. Sci. USA, 96 (1999), pp. 11830-11835
- 5 H. Hasuwa, Y. Shishido, A. Yamazaki, T. Kobayashi, X Yu, E. Mekada
CD9 Amino acids critical for upregulation of diphtheria toxin binding
Biochem. Biophys. Res. Commun., 289 (2001), pp. 782-790
Article  PDF (279KB)
- 6 A. Higginbottom, E.R. Quinn, C.C. Kuo, M. Flint, L.H. Wilson, E. Bianchi, A. Nicosia, P.N. Monk, J.A. McKeating, S. Levy
Identification of amino acid residues in CD81 critical for interaction with hepatitis C virus envelope glycoprotein E2
J. Virol., 74 (2000), pp. 3642-3649
- 7 K. Kaji, S. Oda, T. Shikano, T. Ohnuki, Y. Uematsu, J. Sakagami, N. Tada, S. Miyazaki, A. Kudo
The gamete fusion process is defective in eggs of Cd9-deficient mice
Nat. Genet., 24 (2000), pp. 279-282
- 8 F. Le Naour, E. Rubinstein, C. Jasmin, M. Prenant, C. Boucheix
Severely reduced female fertility in CD9-deficient mice
Science, 287 (2000), pp. 319-321
- 9 B.J. Miller, E. Georges-Labouesse, P. Primakoff, D.G. Myles
Normal fertilization occurs with eggs lacking the integrin alpha6beta1 and is CD9-dependent
J. Cell Biol., 12 (2000), pp. 1289-1296
- 10 K. Miyado, G. Yamada, S. Yamada, H. Hasuwa, Y. Nakamura, F. Ryu, K. Suzuki, K. Kosai, K. Inoue, A. Ogura, M. Okabe, E. Mekada
Requirement of CD9 on the egg plasma membrane for fertilization
Science, 287 (2000), pp. 321-324
- 11 K. Nakamura, T. Mitamura, T. Takahashi, T. Kobayashi, E. Mekada
Importance of the major extracellular domain of CD9 and the epidermal growth factor (EGF)-like domain of heparin-binding EGF-like growth factor for up-regulation of binding and activity
J. Biol. Chem., 275 (2000), pp. 18284-18290
- 12 L. Neilson, A. Andalibi, D. Kang, C. Coutifaris, J.F. Strauss III, J.-A.L. Stanton, D.P.L. Green
Molecular phenotype of the human oocyte by PCR-SAGE
Genomics, 63 (2000), pp. 13-24
Article  PDF (88KB)
- 13 P. Pileri, Y. Uematsu, S. Campagnoli, G. Galli, F. Falugi, R. Petracca, A.J. Weiner, M. Houghton, D. Rosa, G. Grandi, S. Abrignani
Binding of hepatitis C virus to CD81
Science, 282 (1998), pp. 938-941
- 14 G. Seydoux
Mechanisms of translational control in early development
Curr. Opin. Genet. Dev., 6 (1996), pp. 555-561
Article  PDF (848KB)
- 15 I. Tachibana, M.E. Hemler
Role of transmembrane 4 superfamily (TM4SF) proteins CD9 and CD81 in muscle cell fusion and myotube maintenance
J. Cell Biol., 146 (1999), pp. 893-904
- 16 Y. Takahashi, D. Bigler, Y. Ito, J.M. White
Sequence-specific interaction between the disintegrin domain of mouse ADAM 3 and murine eggs: Role of beta1 integrin-associated proteins CD9, CD81, and CD98
Mol. Biol. Cell, 12 (2001), pp. 809-820

- 17 J. Tay, R. Hodgman, J.D. Richter
The control of cyclin B1 mRNA translation during mouse oocyte maturation
Dev. Biol., 221 (2000), pp. 1-9
[Article](#)  [PDF \(201KB\)](#)
- 18 J.D. Vassalli, J. Huarte, D. Belin, P. Gubler, A. Vassalli, M.L. O'Connell, L.A. Parton, R.J. Rickles, S. Strickland
Regulated polyadenylation controls mRNA translation during meiotic maturation of mouse oocytes
Genes Dev., 3 (1989), pp. 2163-2171
- 19 C.J. Williams, R.M. Schultz, G.S. Kopf
Role of G proteins in mouse egg activation: Stimulatory effects of acetylcholine on the ZP2 to ZP2f conversion and pronuclear formation in eggs expressing a functional m1 muscarinic receptor
Dev. Biol., 151 (1992), pp. 288-296
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