

Fecundación en mamíferos

Mecanismos Celulares y Moleculares.

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21-Oct.-05

Interacción Espermatozoide-Oocito e Inducción de la RA

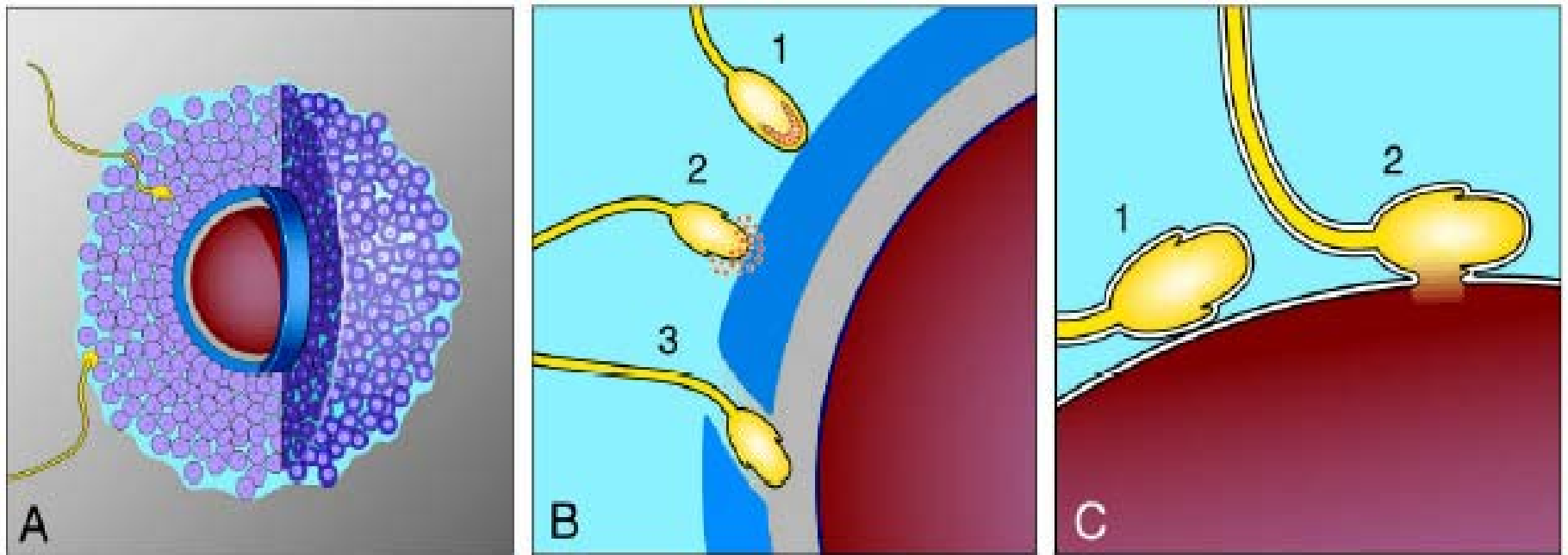


Fig. 1. (A) Sperm penetration of cumulus cells (purple) to reach zona (navy blue). (B) Egg depicted with cumulus cells removed; sperm 1 binds to the zona pellucida (navy blue); sperm 2 undergoes exocytosis, releasing acrosomal contents (orange-red); sperm 3 penetrates the

zona pellucida and begins entry into perivitelline space (gray). (C) Sperm 1 binds to the egg plasma membrane by the side of its head, in a central region (equatorial region); sperm 2 fuses with the egg plasma membrane.

PROGRESO DE LA REACCION ACROSOMICA

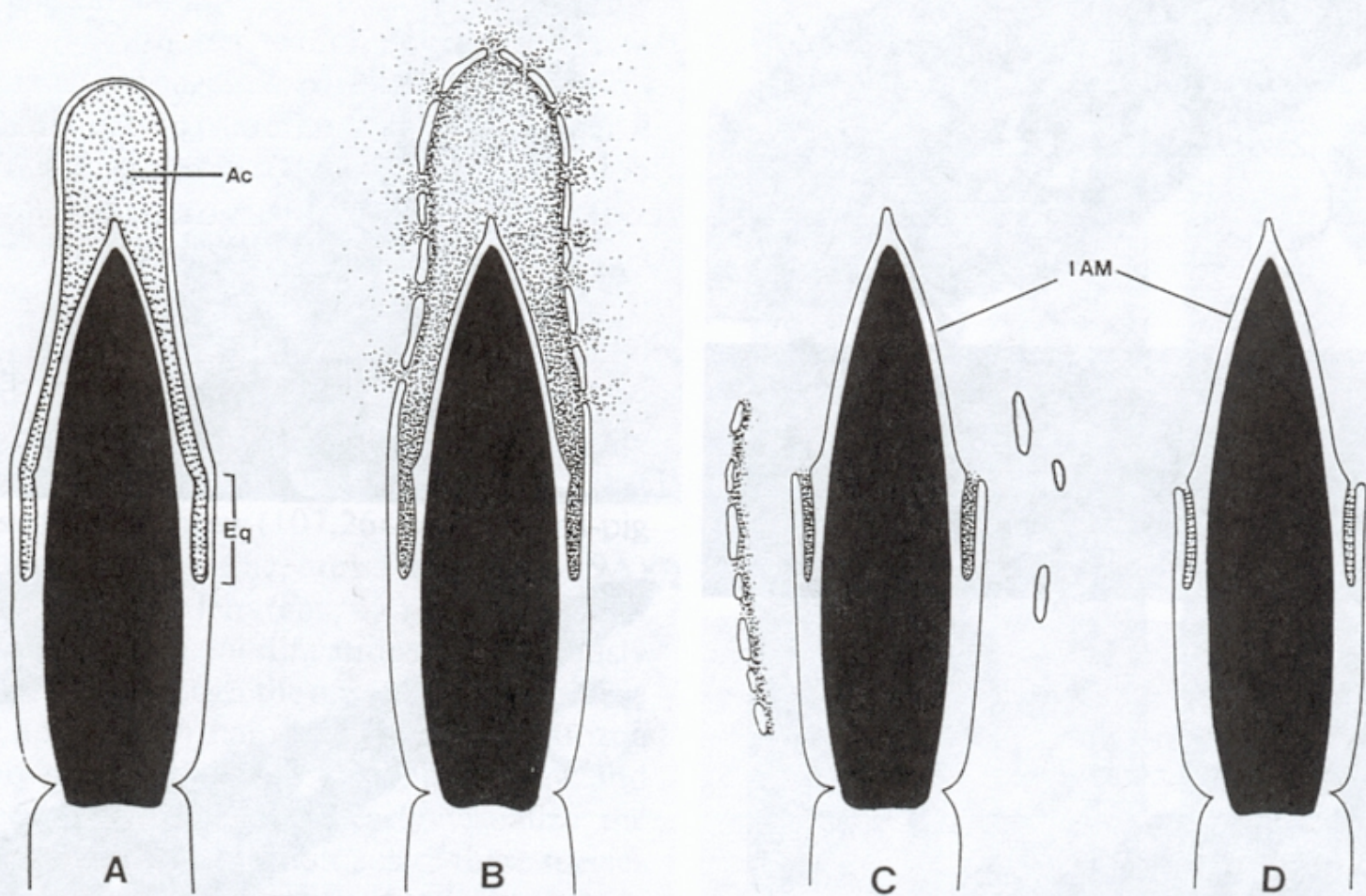
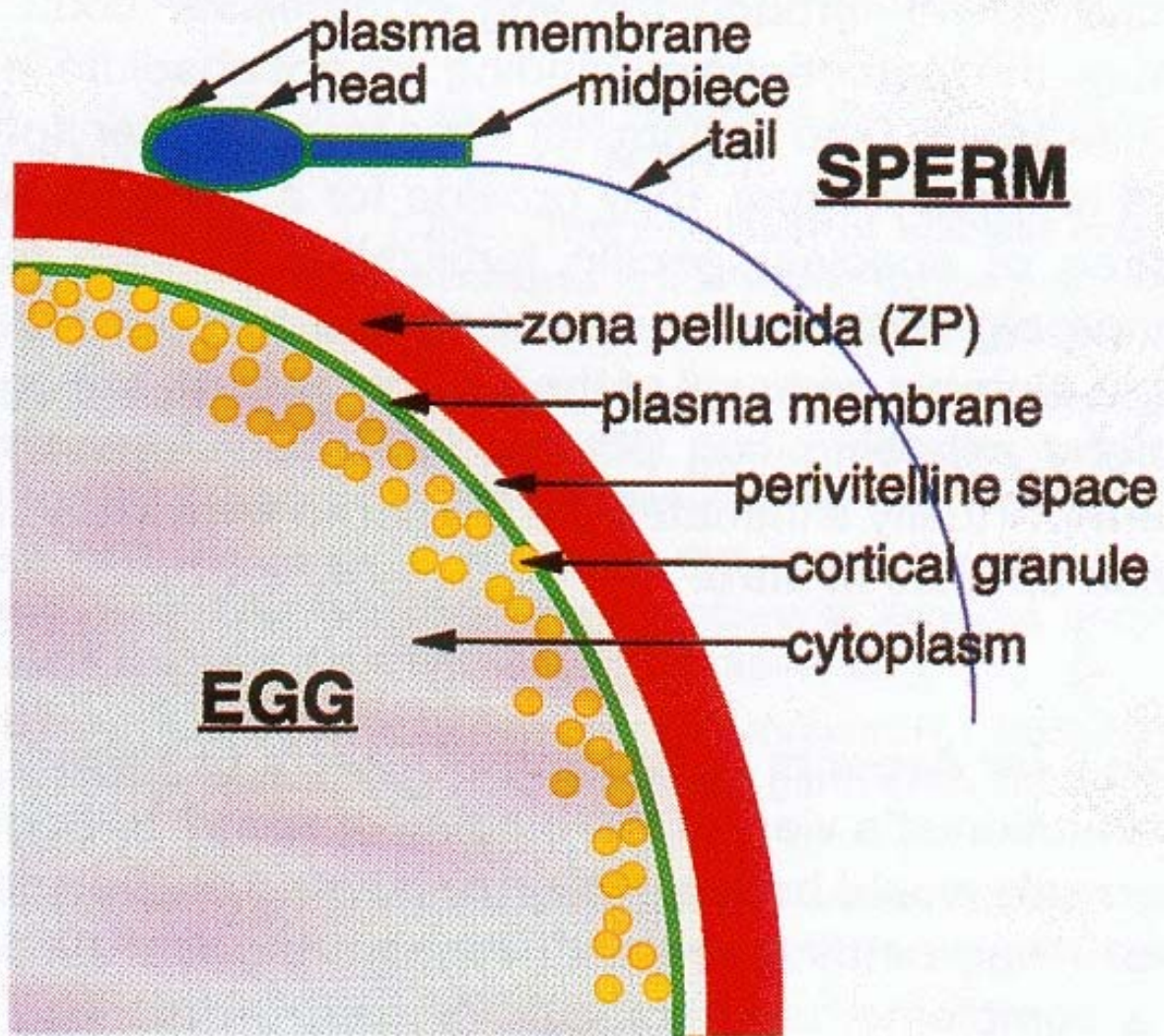
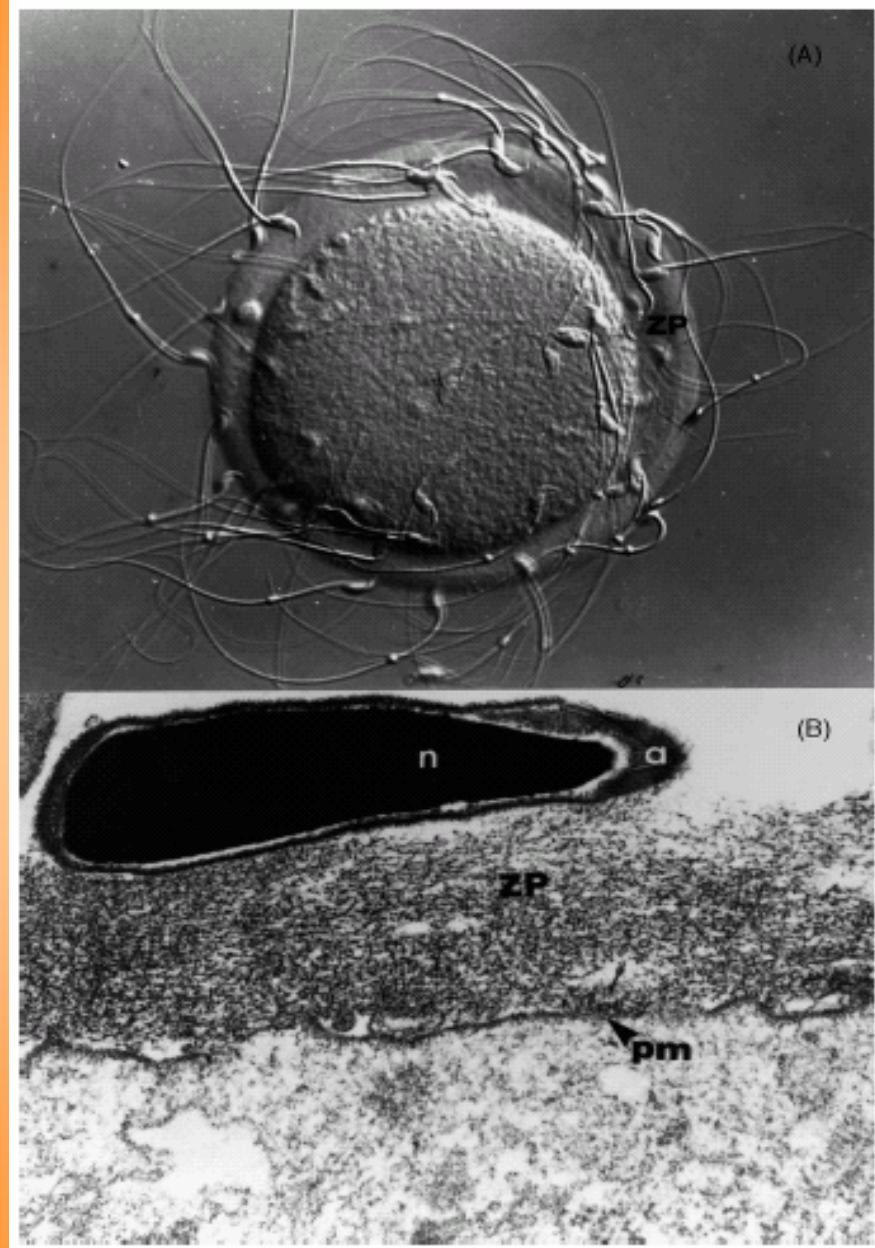


FIG. 16. Diagrams illustrating the progression of the acrosome reaction. (A) Before the reaction. (B) The reaction in progress; multiple fusions between the plasma and outer acrosomal membrane allow the release or exposure of acrosomal contents (enzymes). (C–D) The reaction is completed; vesiculated membranes are held together by a “sticky” acrosomal matrix or disperse. Ac, Acrosomal cap; Eq, equatorial segment; IAM, inner acrosomal membrane. (Modified slightly from ref. 530.)

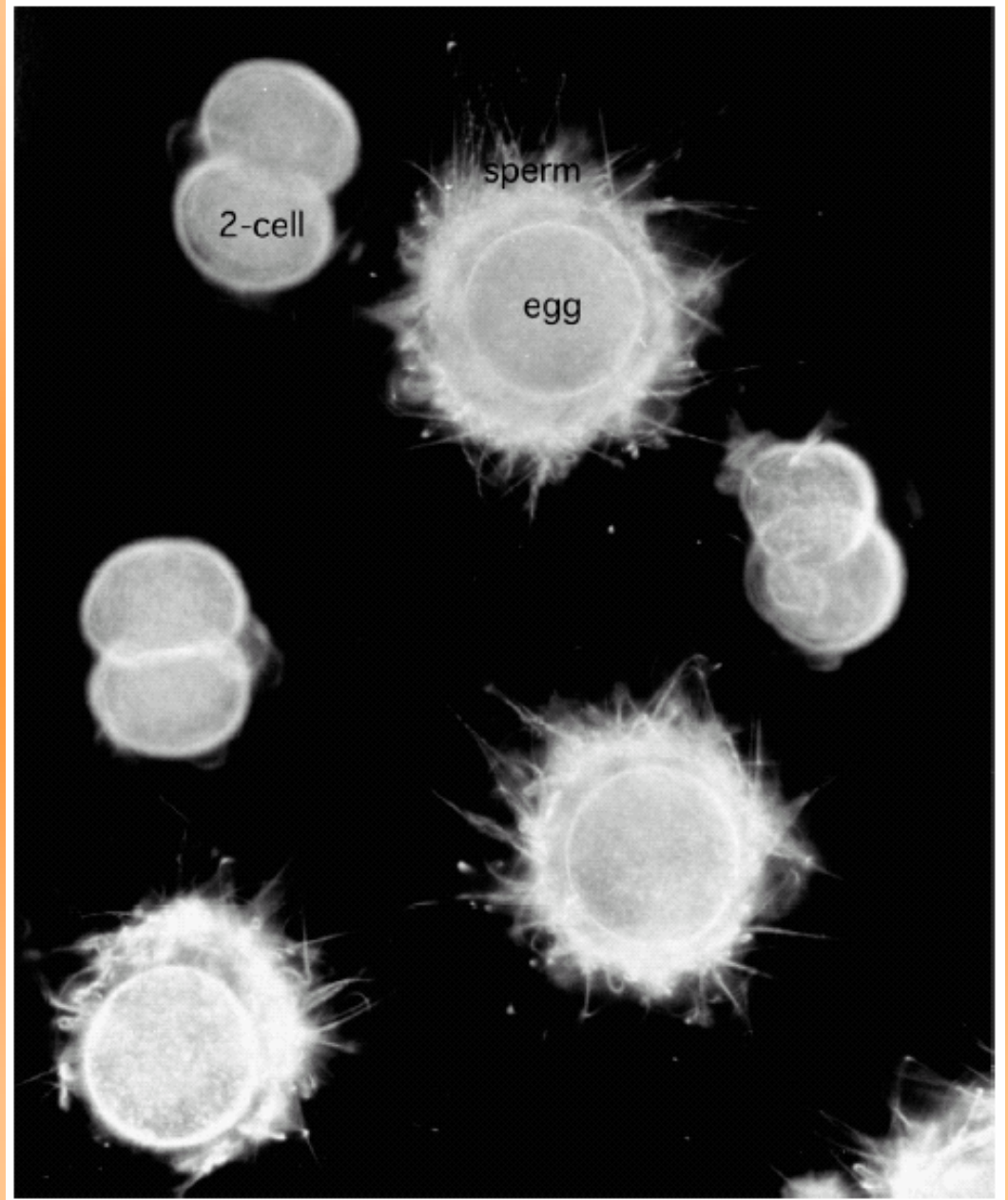
Binding of Acrosome-Intact Sperm to Egg ZP



**Interacción Espermatozoide
Zona Pelúcida
(Nomarski y Microscopía
Electrónica de Transmisión)**

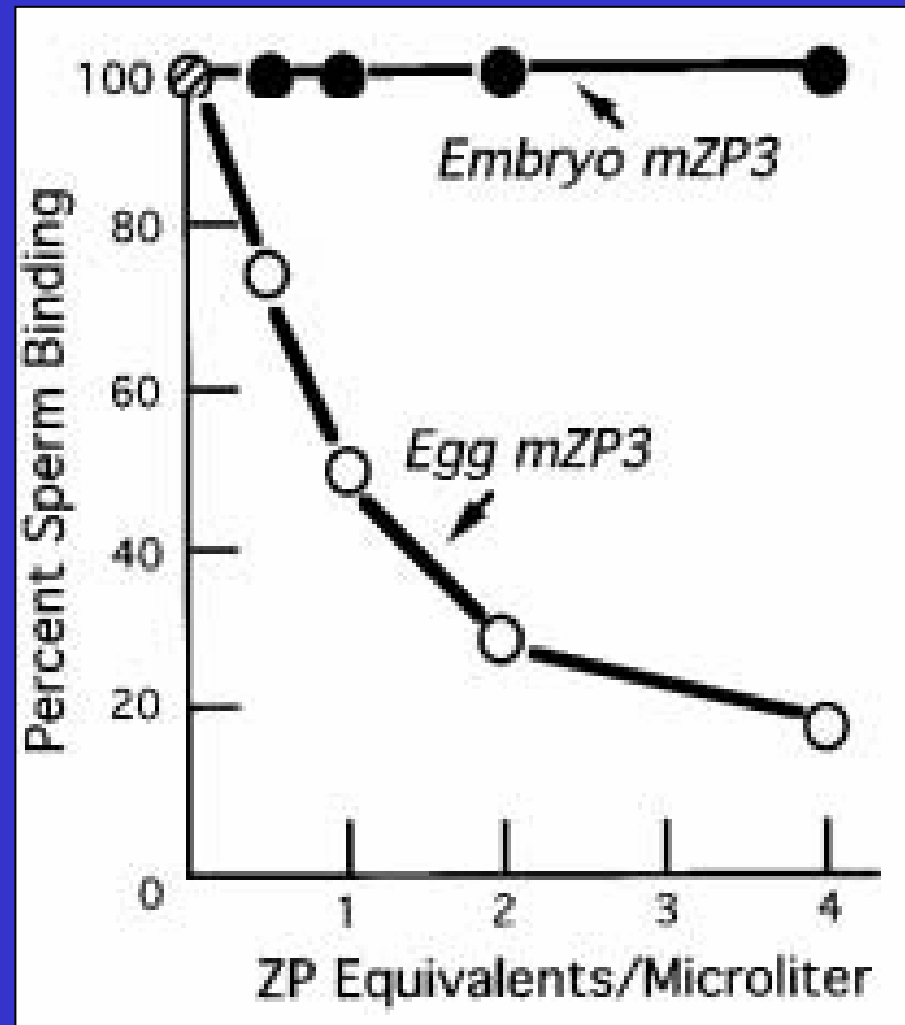
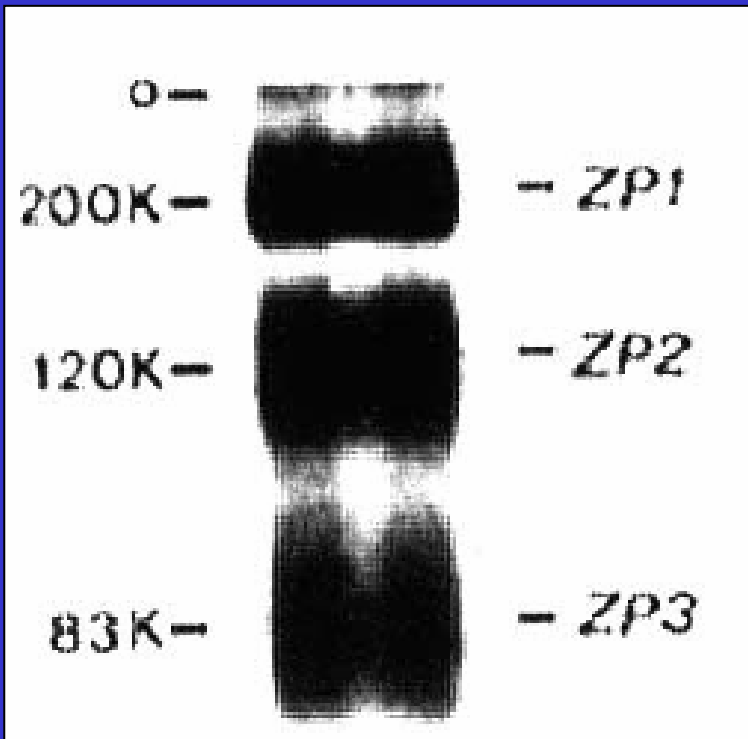


**Interacción Espermatozoide-
Zona Pelúcida. (Nomarski)
Oocito y Embrión de 2 Células**



Competencia mZP3 soluble y unión al oocito

Glicoproteínas de la ZP



Binding of Sperm to Zona Pellucida Filaments

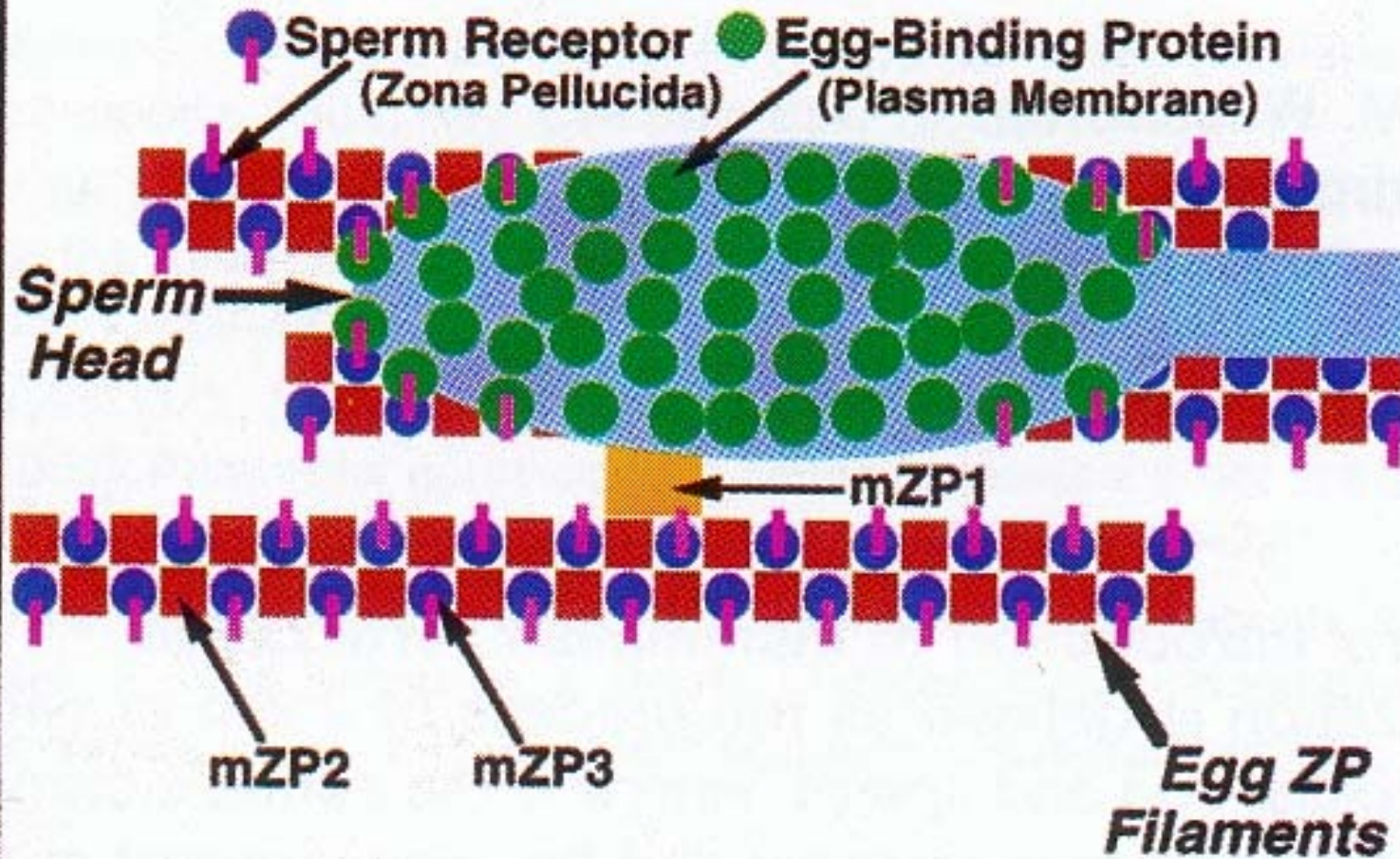
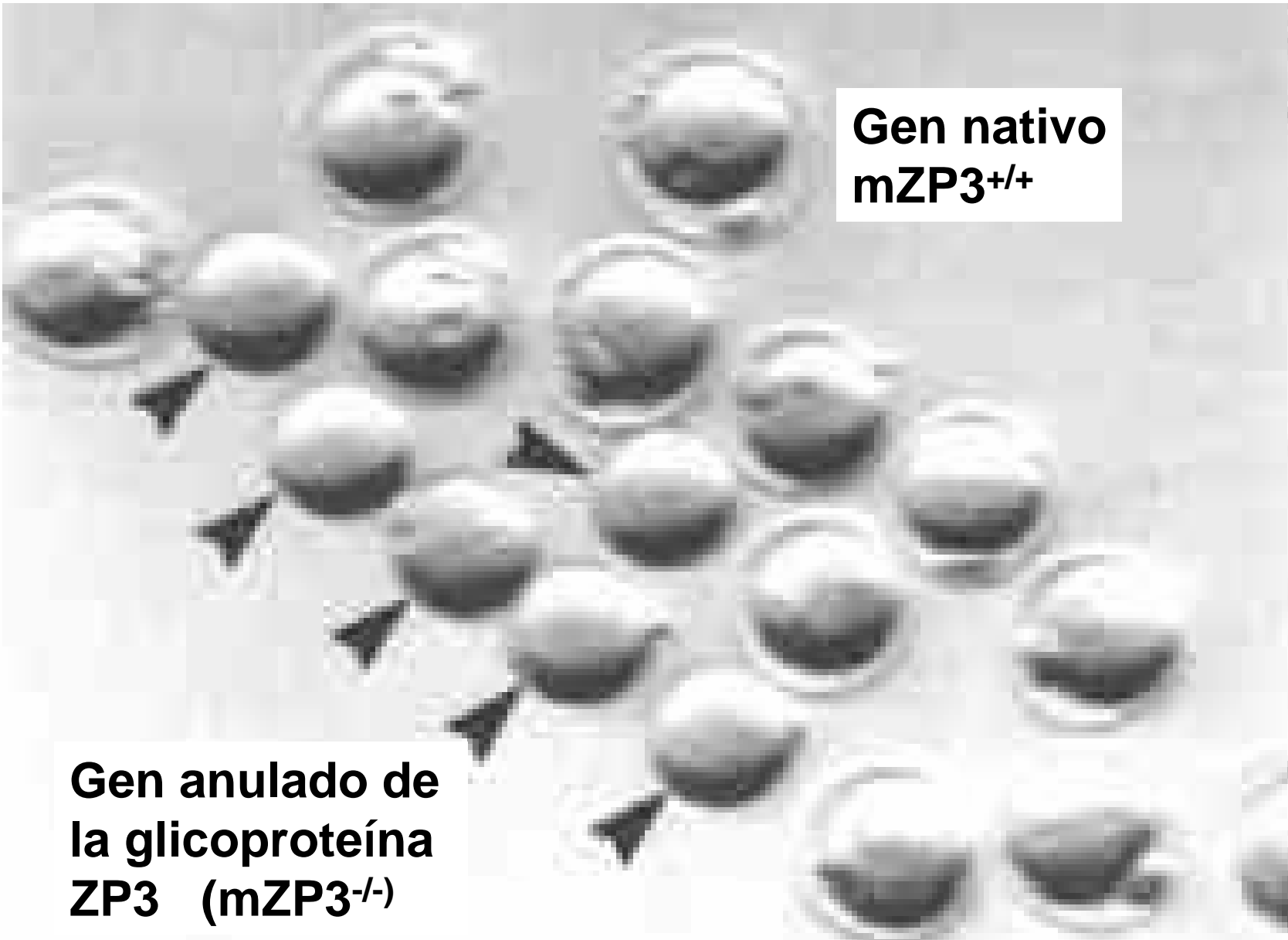




Table 1. Gamete surface proteins and zona pellucida proteins with reported gene knockout.

Gamete protein	KO phenotype: Major features
Sperm protein	
Galactosyl transferase	Fertile males; ZP3-induced acrosome reaction is defective; increase in sperm binding to zona (10)
Egg protein	
ZP1, ZP2	Infertile females; structurally defective zona (43, 44)
ZP3	Infertile females; no zona made (45, 46)



Gen nativo
mZP3^{+/-}

This electron micrograph shows a cluster of oocytes from a mouse with a heterozygous mutation in the ZP3 gene (mZP3^{+/-}). The oocytes are spherical and appear to have a normal, intact zona pellucida, which is the outermost layer of the cell. Some oocytes show small, dark, triangular structures on their surface, which are likely the zona microvilli. The overall appearance is similar to wild-type oocytes.

Gen anulado de
la glicoproteína
ZP3 (mZP3^{-/-})

This label is positioned at the bottom left of the image, indicating the genotype of the oocytes shown in the adjacent panel. It refers to a homozygous knockout of the ZP3 gene (mZP3^{-/-}), which results in the absence of the ZP3 glycoprotein and a consequently altered zona structure.

INDUCTORES FISIOLÓGICOS DE LA REACCIÓN ACROSÓMICA

- **LA ZONA PELUCIDA DEL OOCITO (ZP3)**
- **LA HORMONA ESTEROIDAL PROGESTERONA**

ESPERMATOZOIDE

Capacitación



Acrosoma



Fecundación

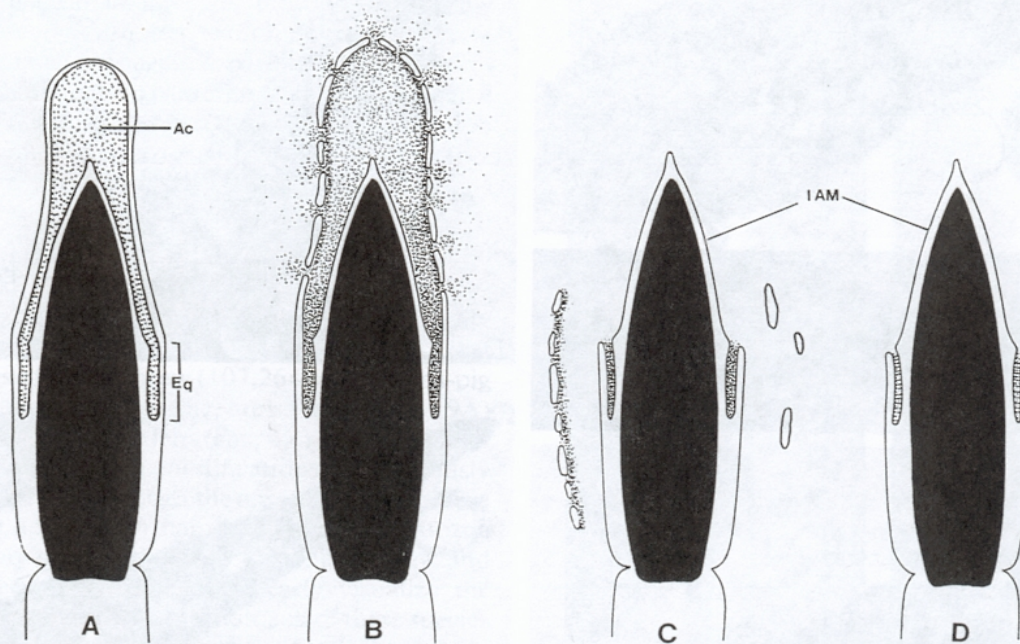
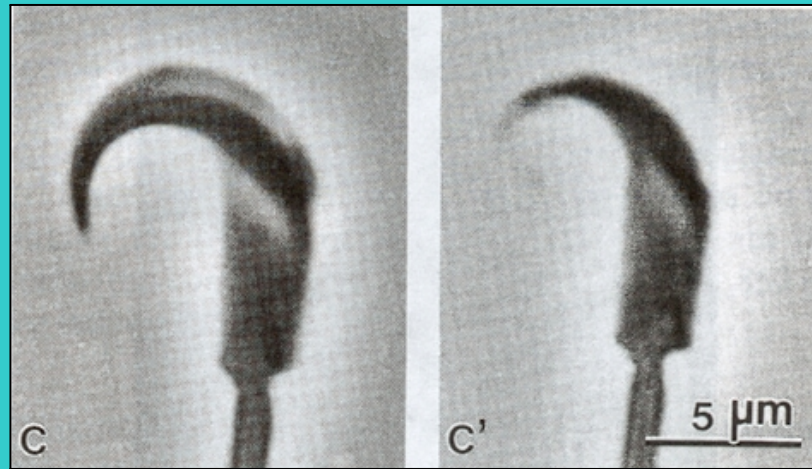
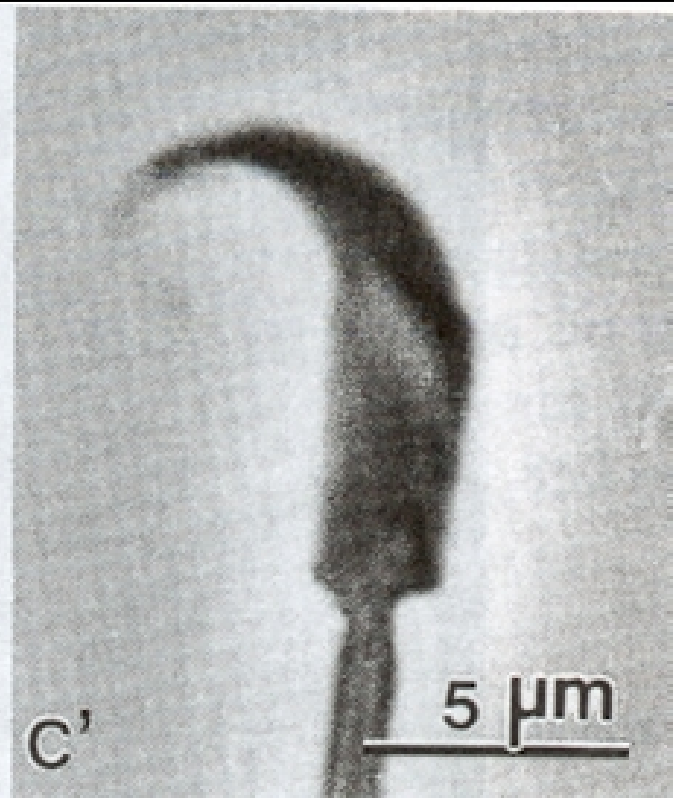


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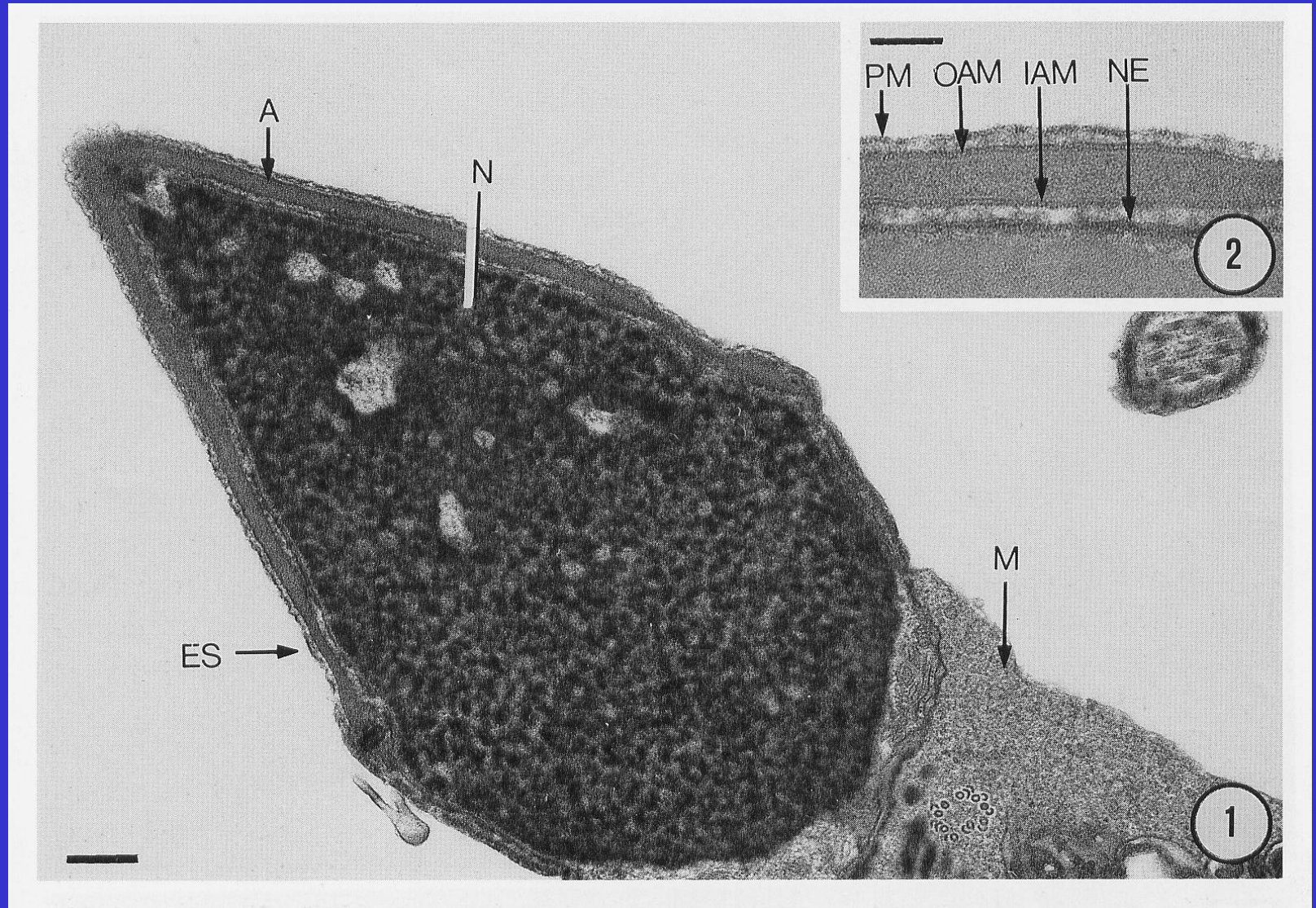


Intacto

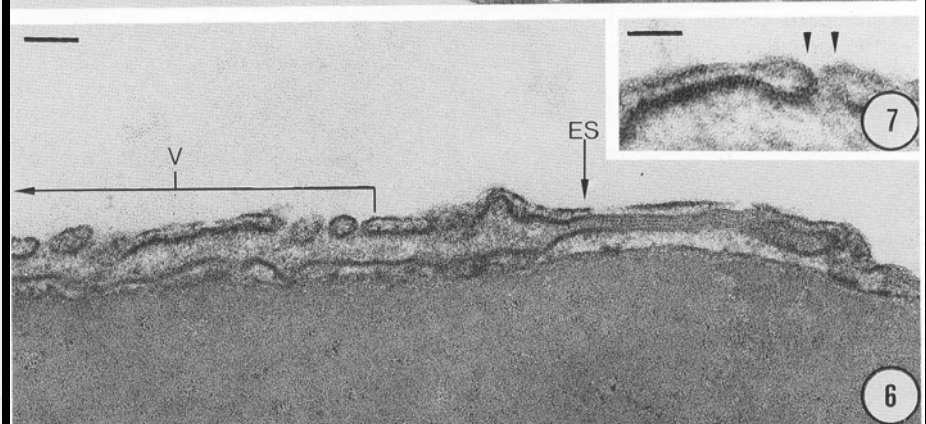
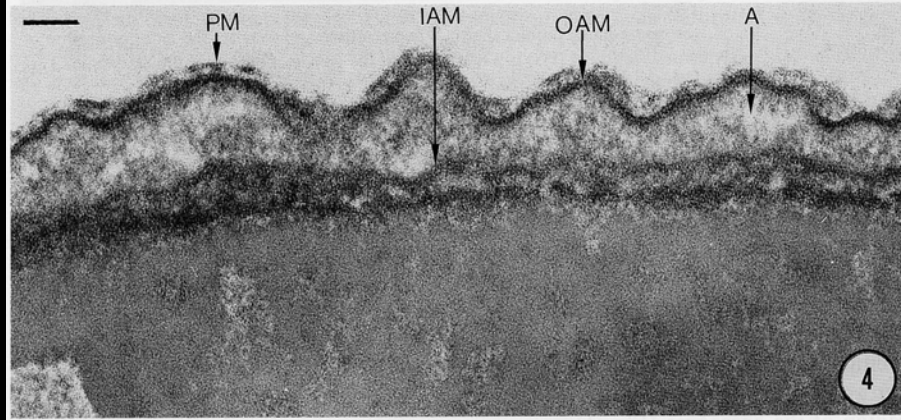
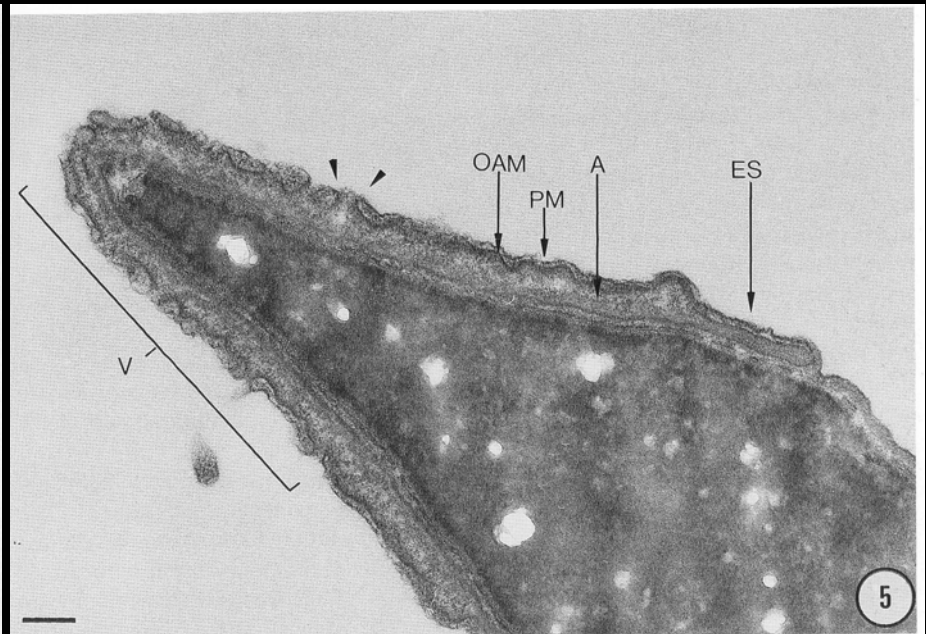
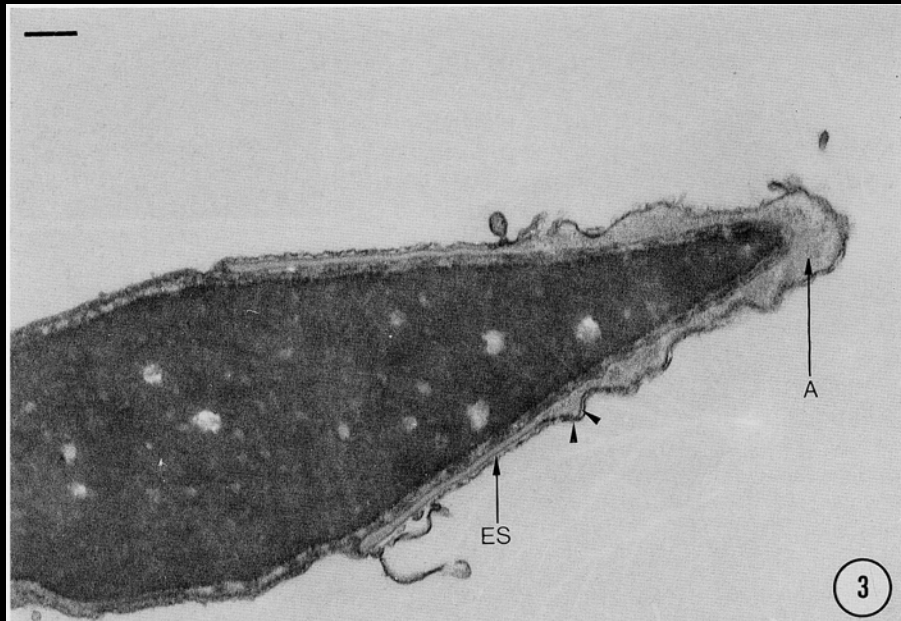


Reaccionado

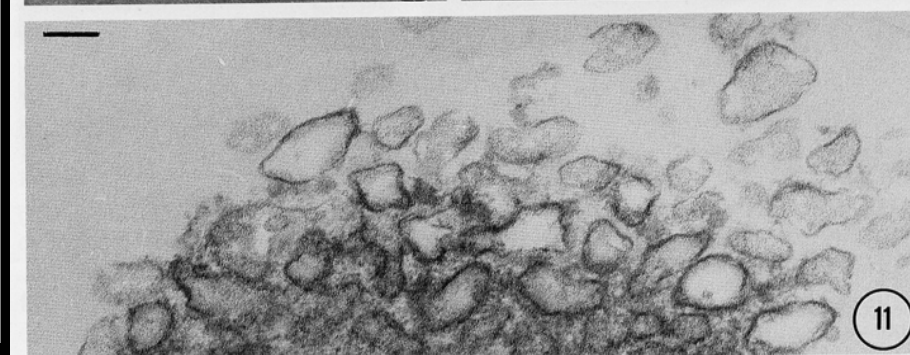
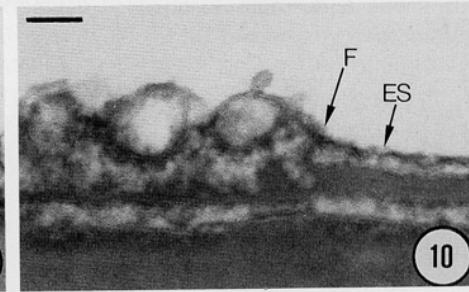
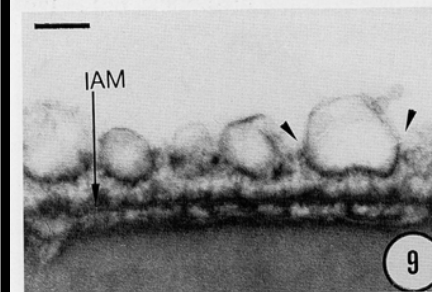
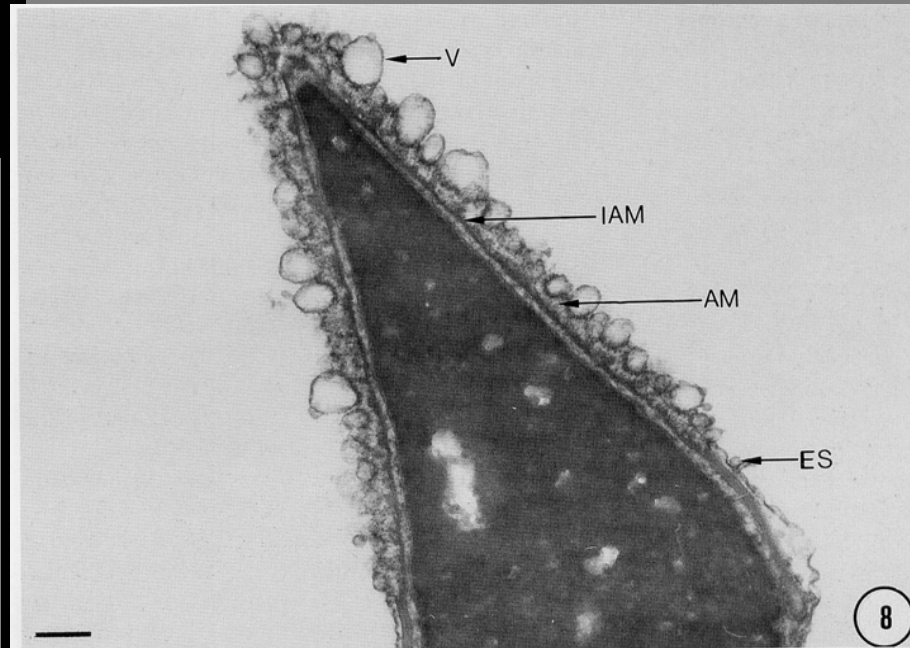
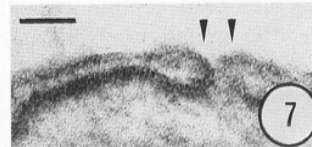
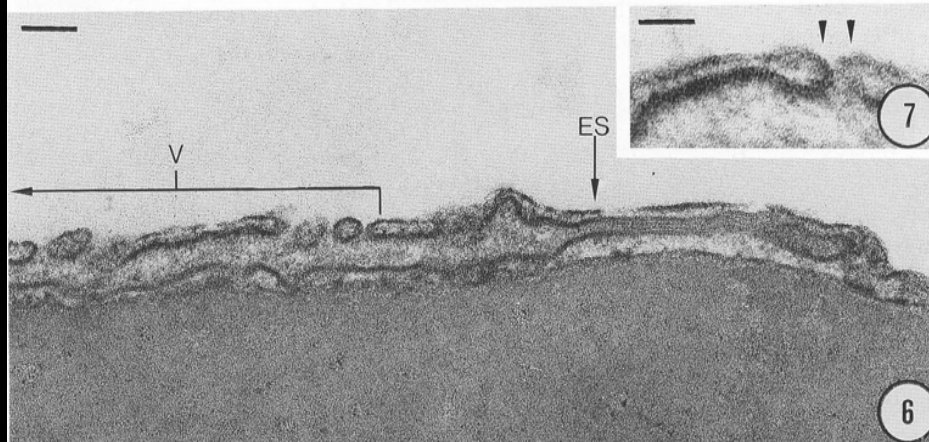
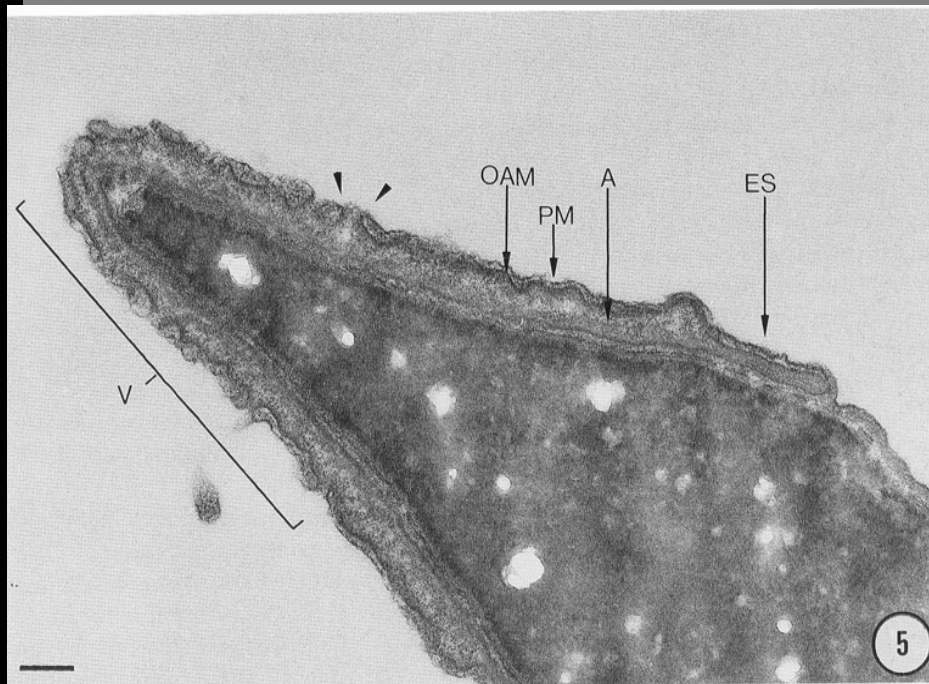
Comienzo Secuencia RA Estimulada por hFF Pre-ovulatorio en Espermatozoides Humanos (I)



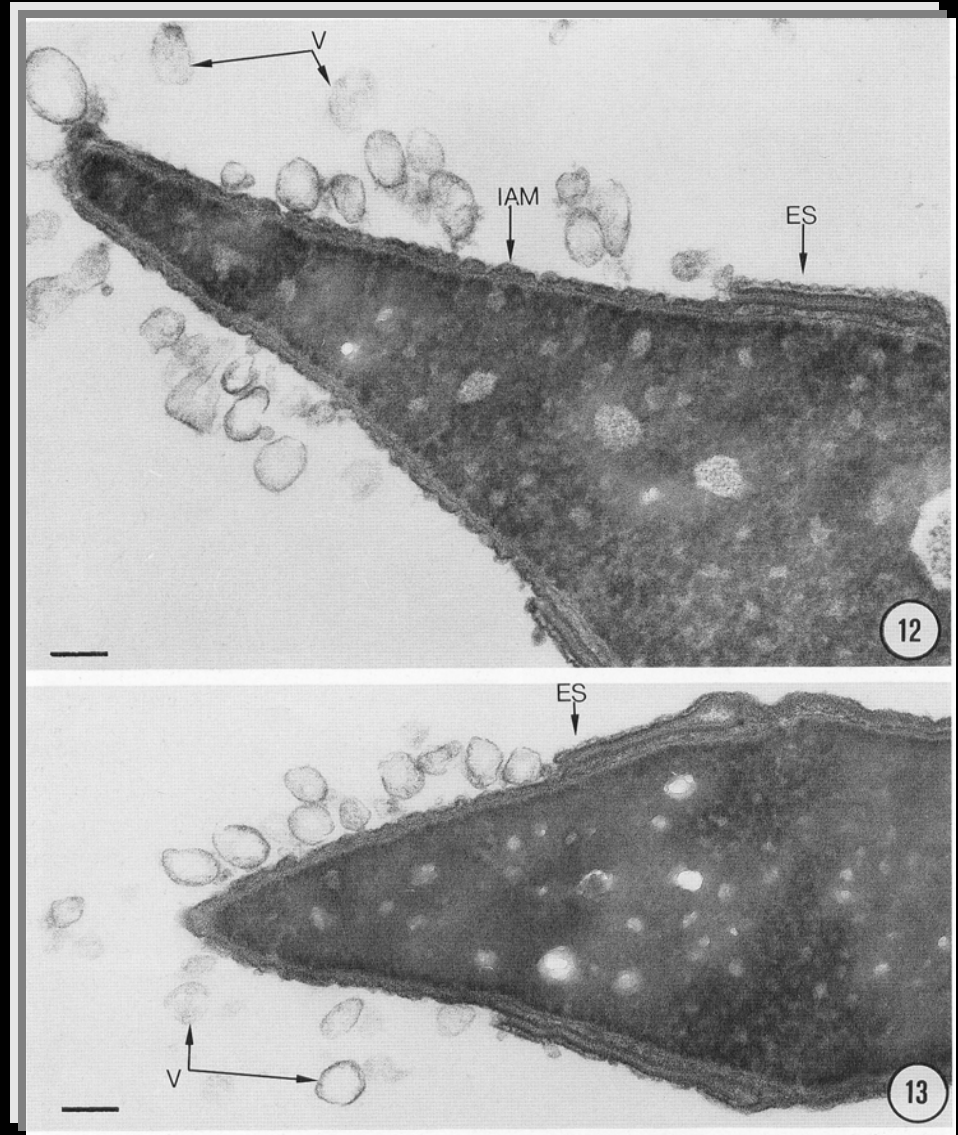
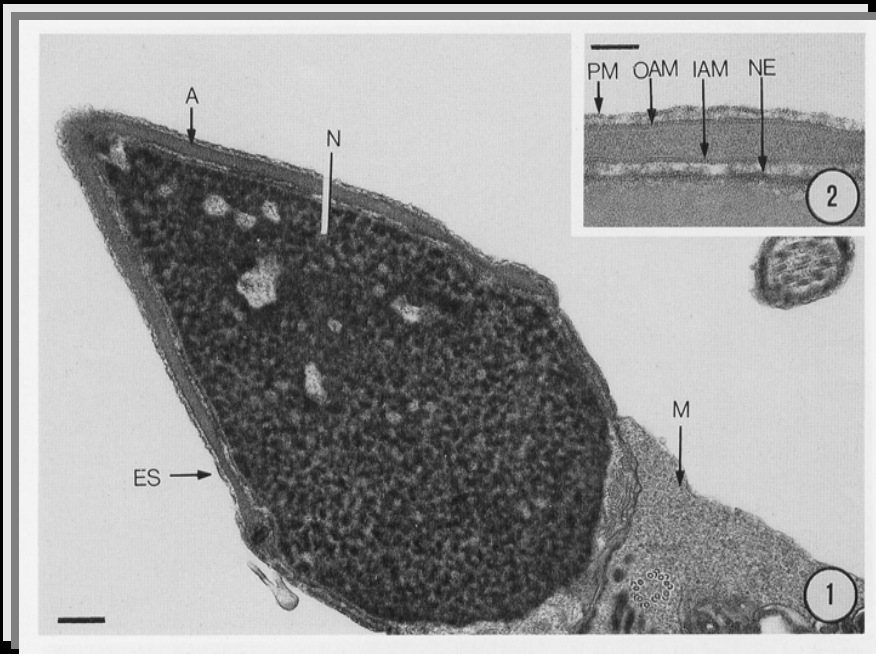
Secuencia RA (II)



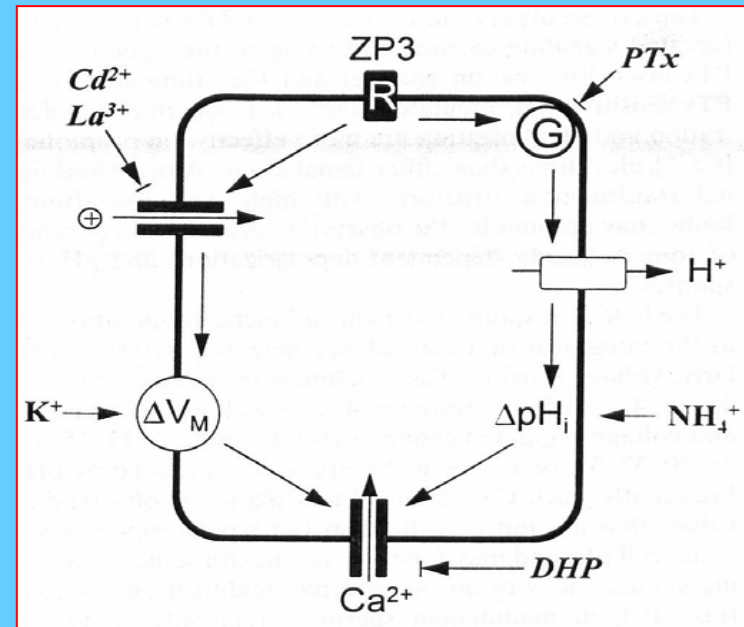
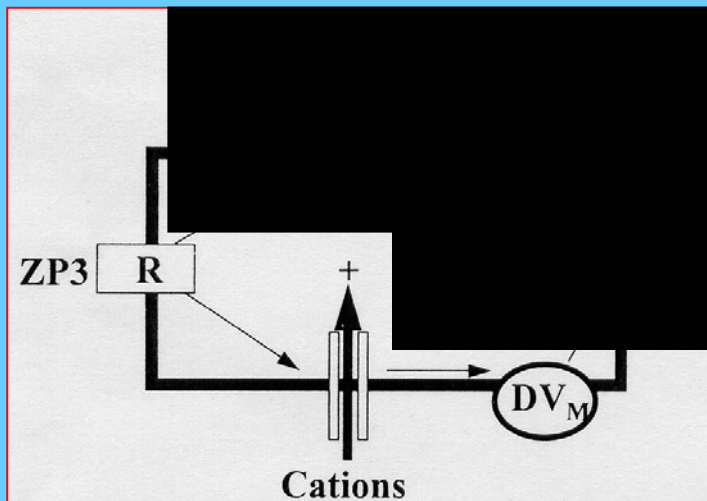
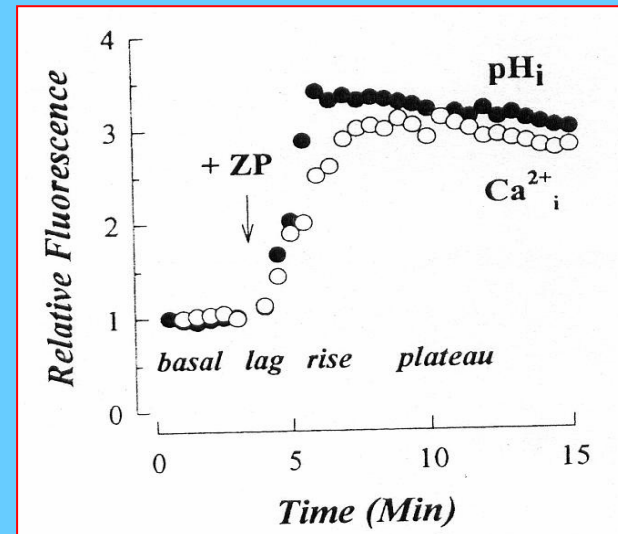
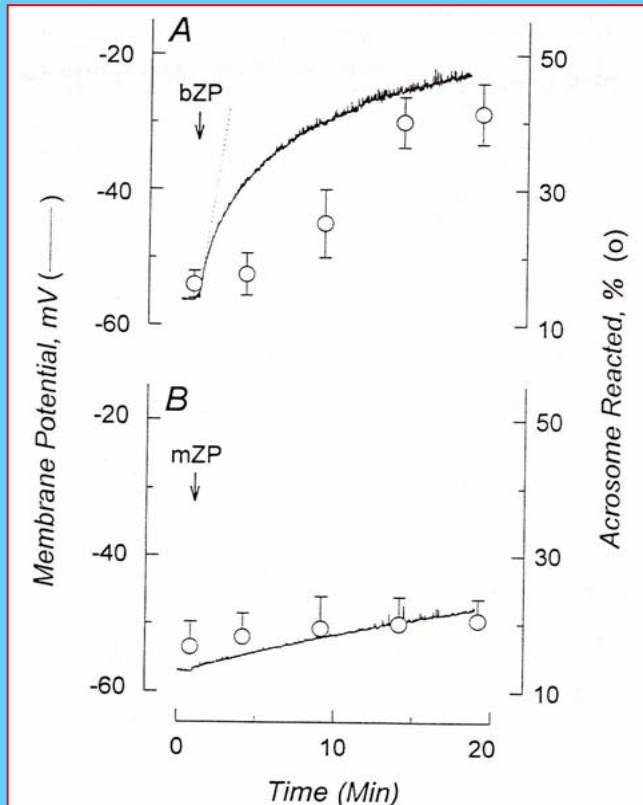
Secuencia RA (III)



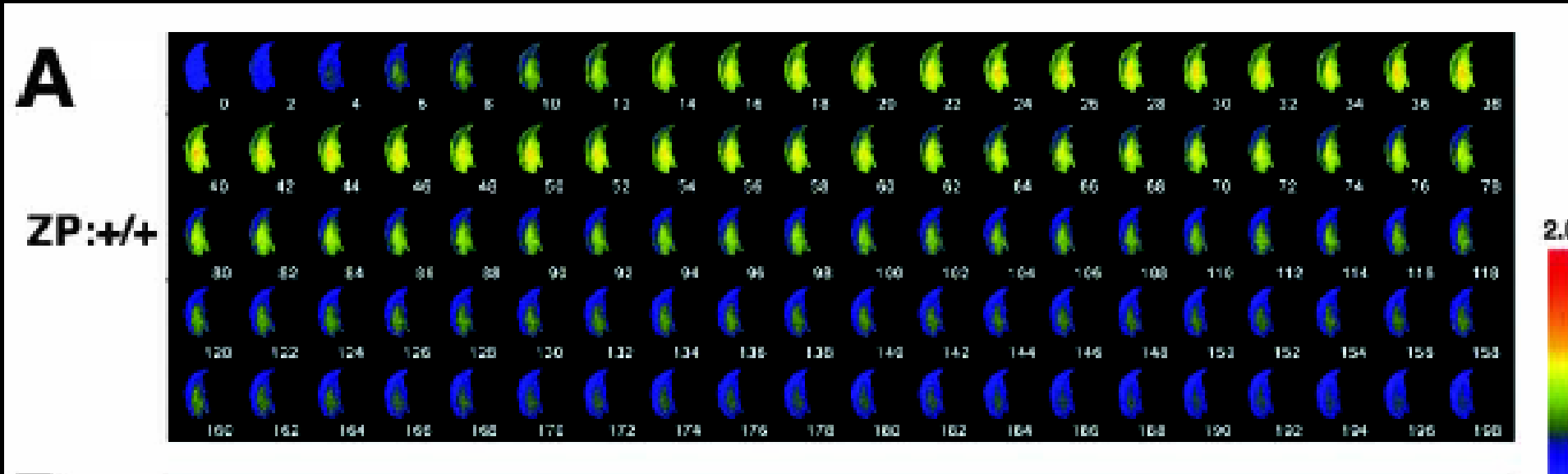
Secuencia RA (IV)



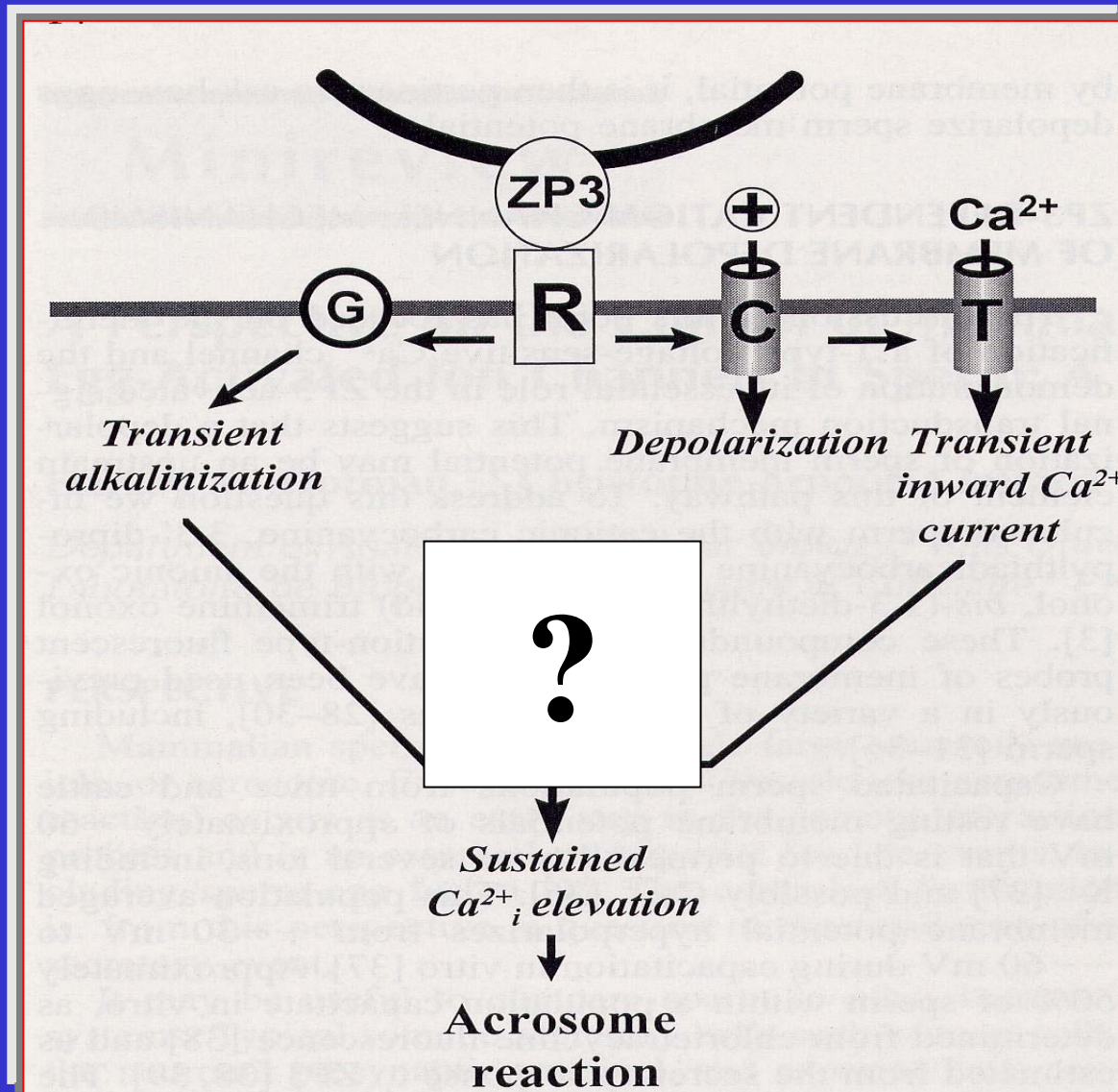
Efectos de ZP en el Espermatozoide Involucrados en la Inducción de la RA



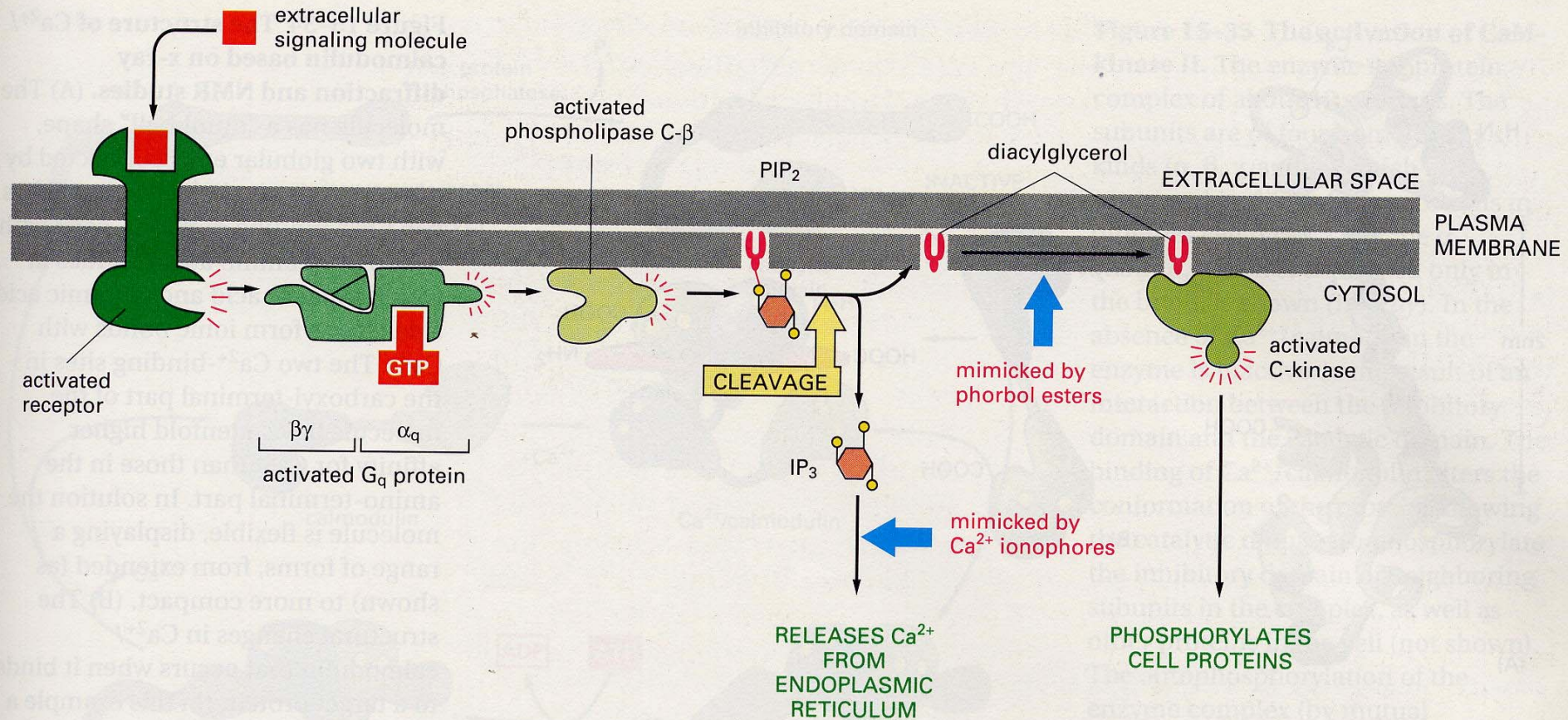
Elevación de calcio intraespermático por acción de ZP soluble
Imágenes microscopía confocal. Tomas en intervalos de 2 seg.
Niveles de fluorescencia se transforman a pseudocolor corres-
A un valor de concentración de calcio libre.



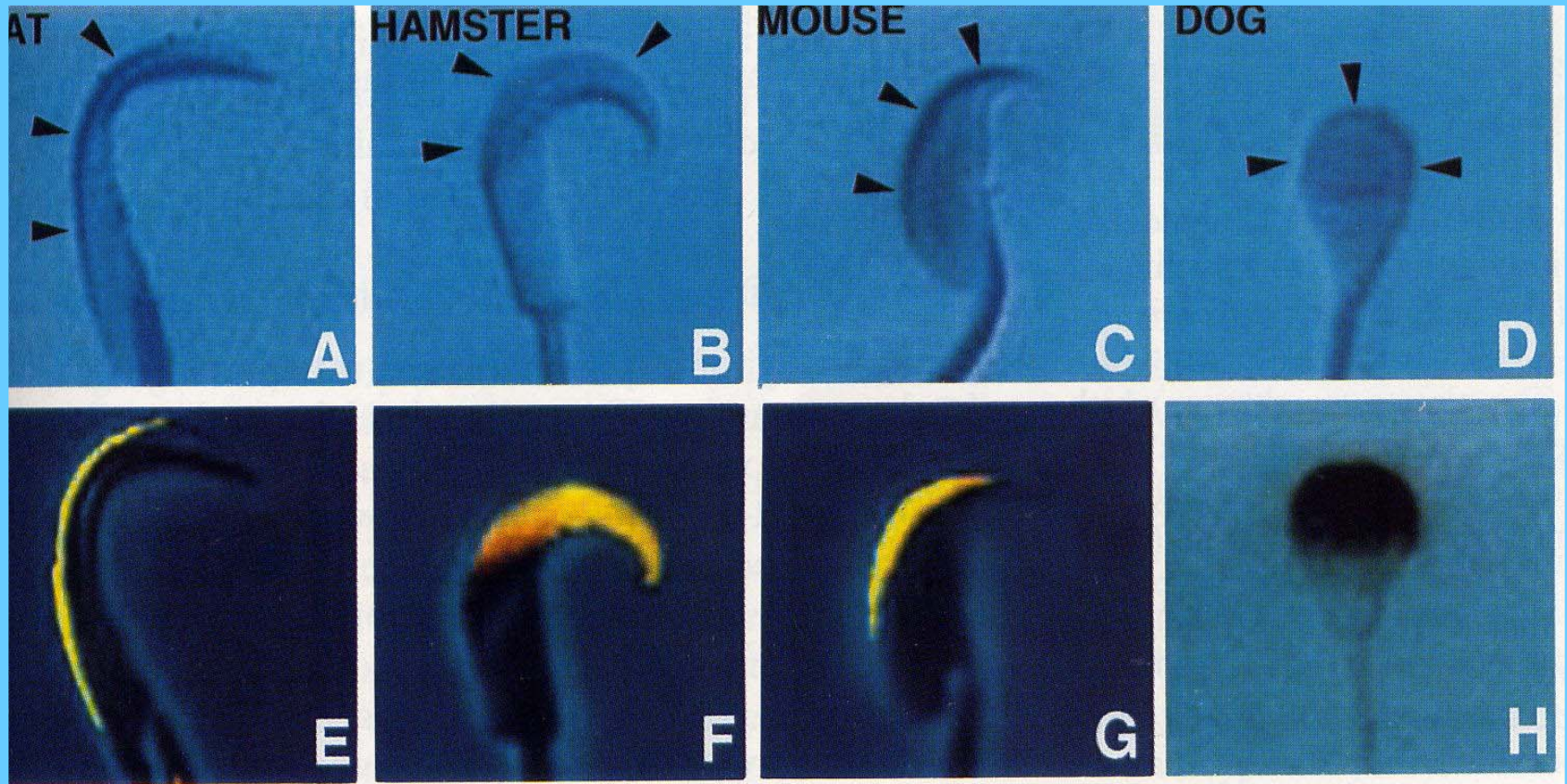
RA y canales T de calcio. Modelo



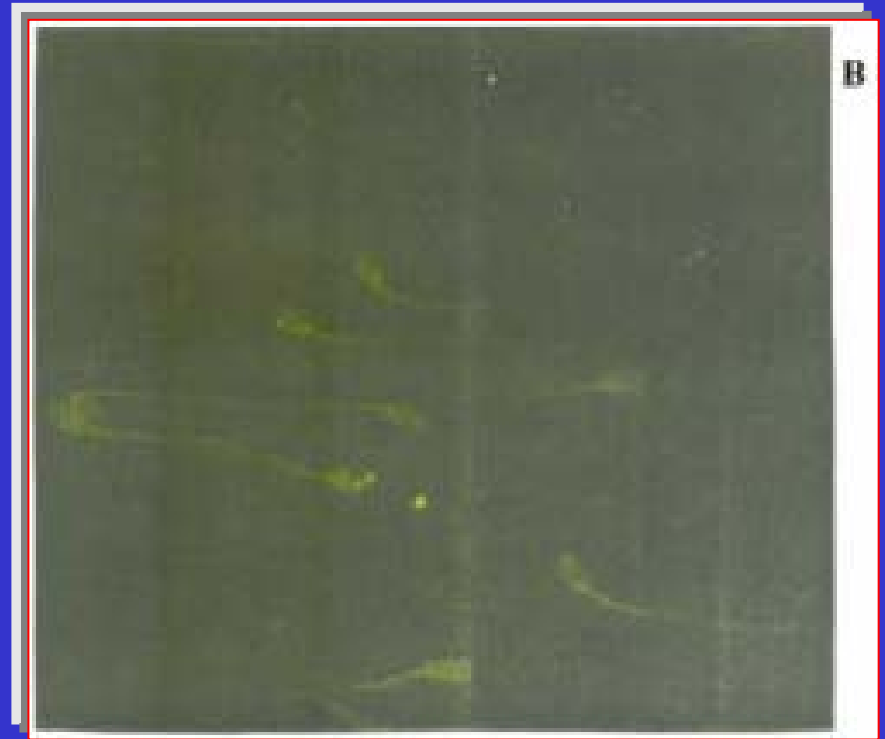
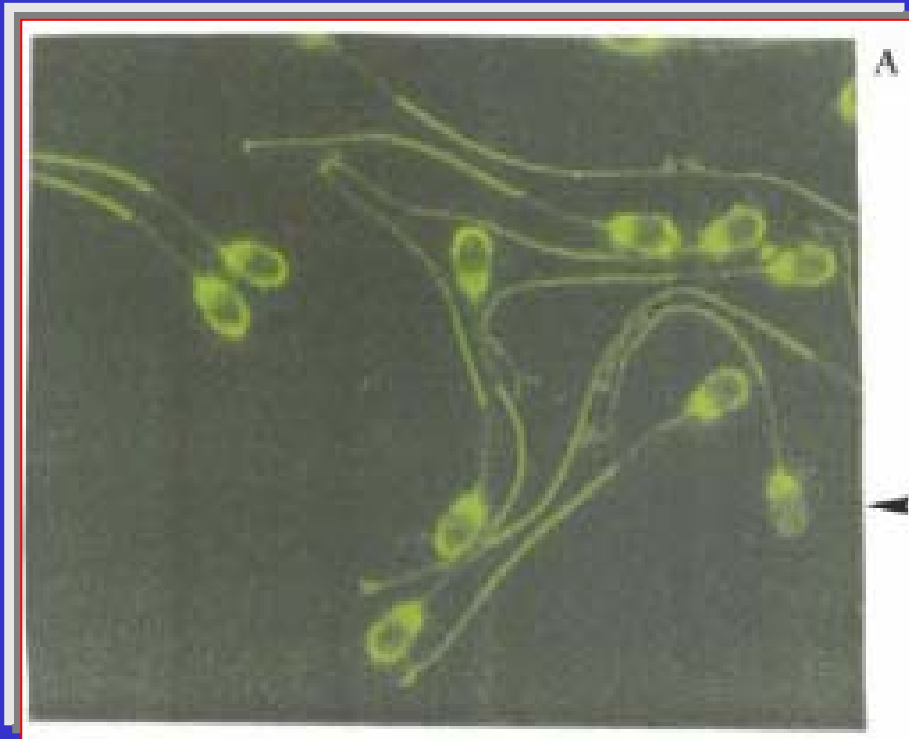
Agonista-Receptor-Prot. G-PLC-IP3-Calcio Intracelular



Localización de Receptores de IP_3 en Espermatozoides de Mamífero.

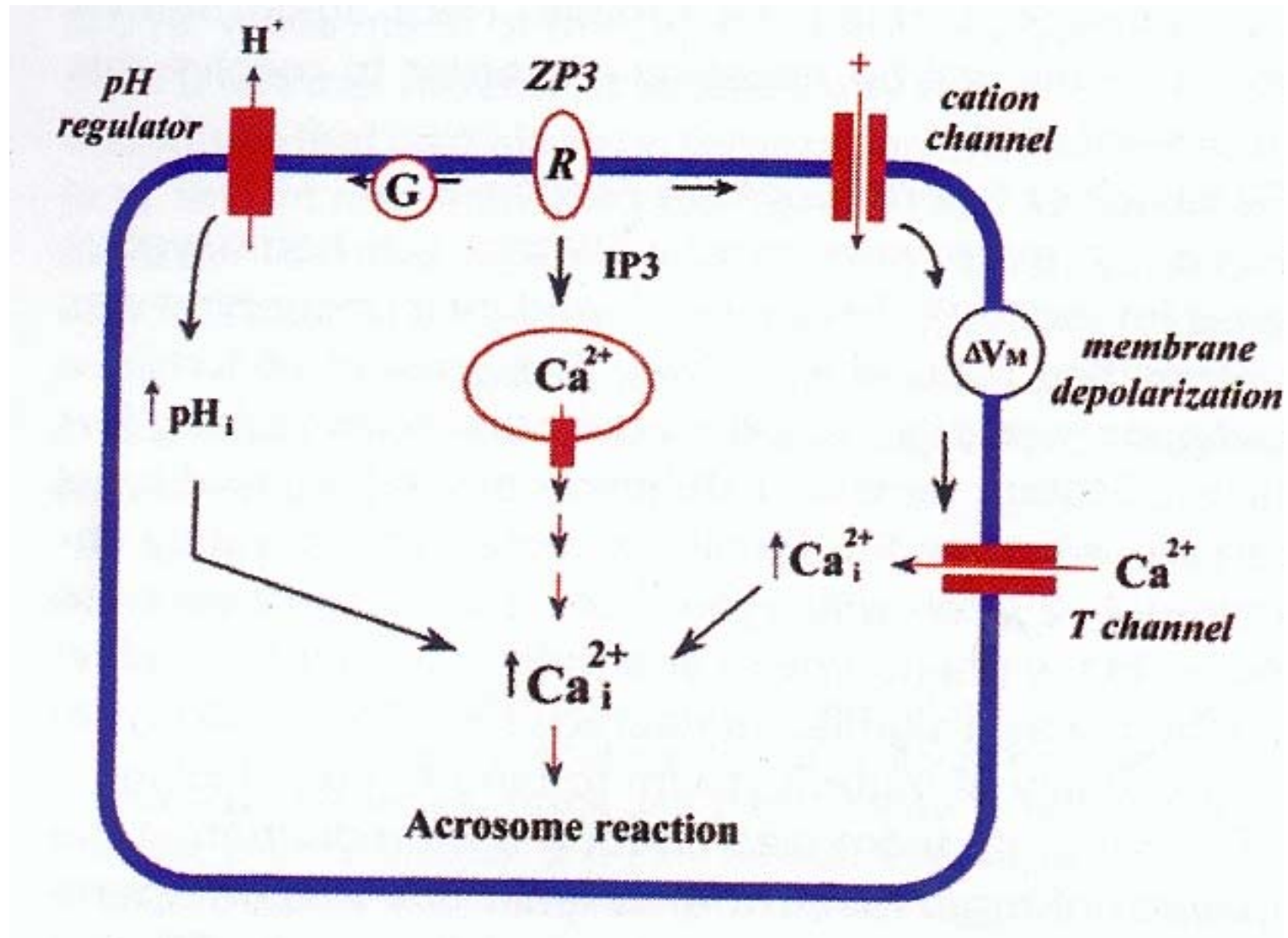


Immunolocalización de receptores de IP3 en espermatozoides de Bovino

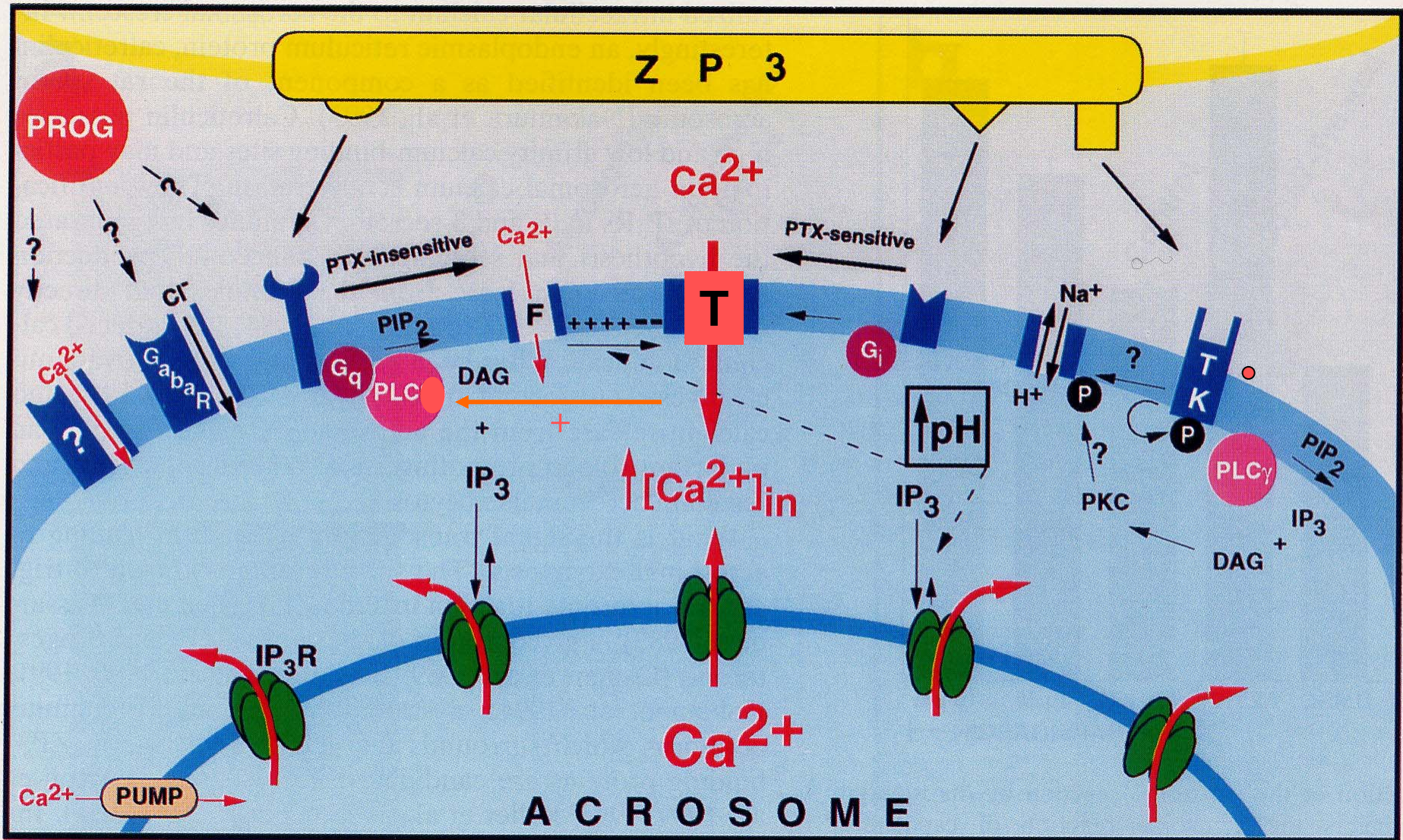


Calcio y RA inducida por ZP3.

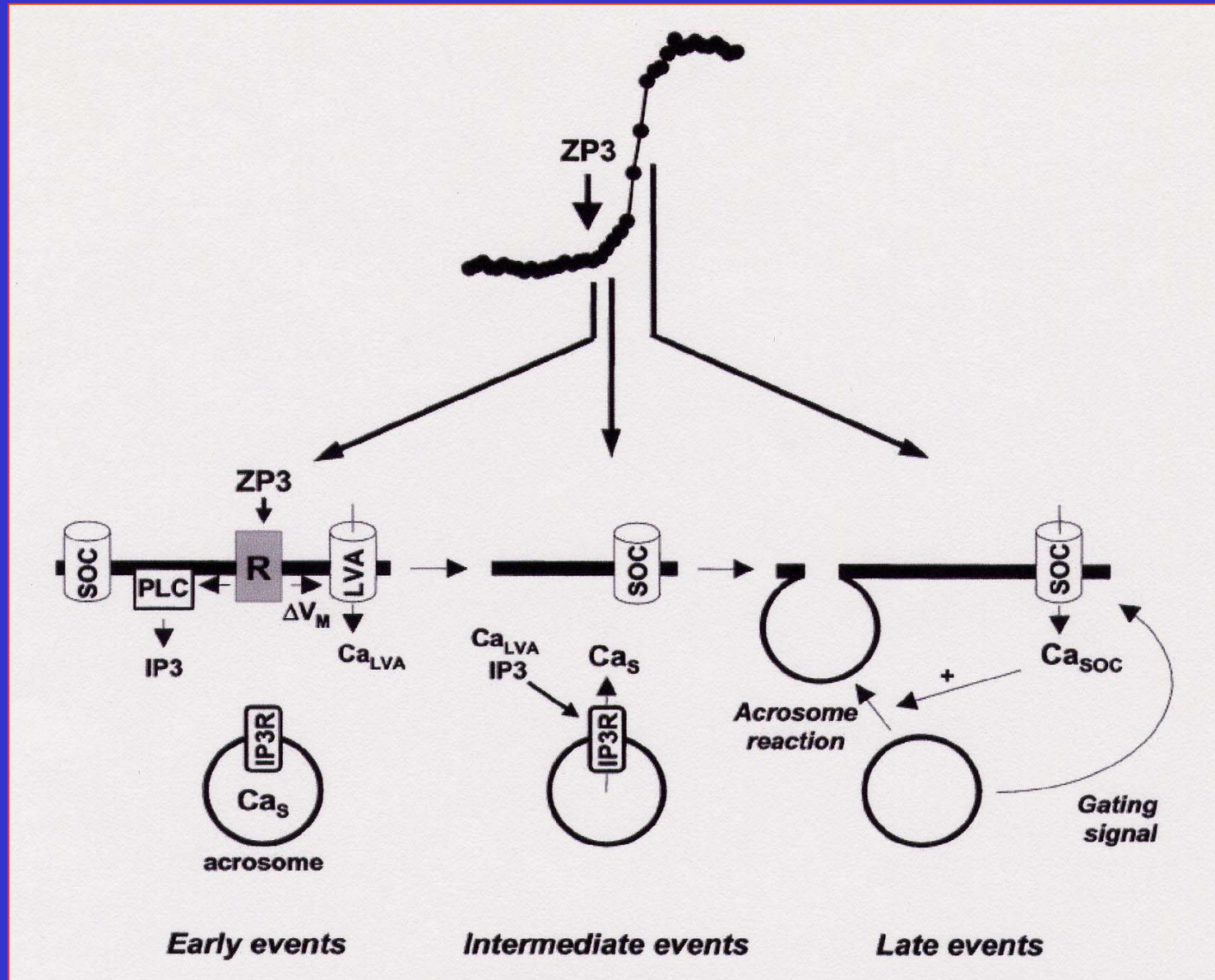
Secuencias. Modelo



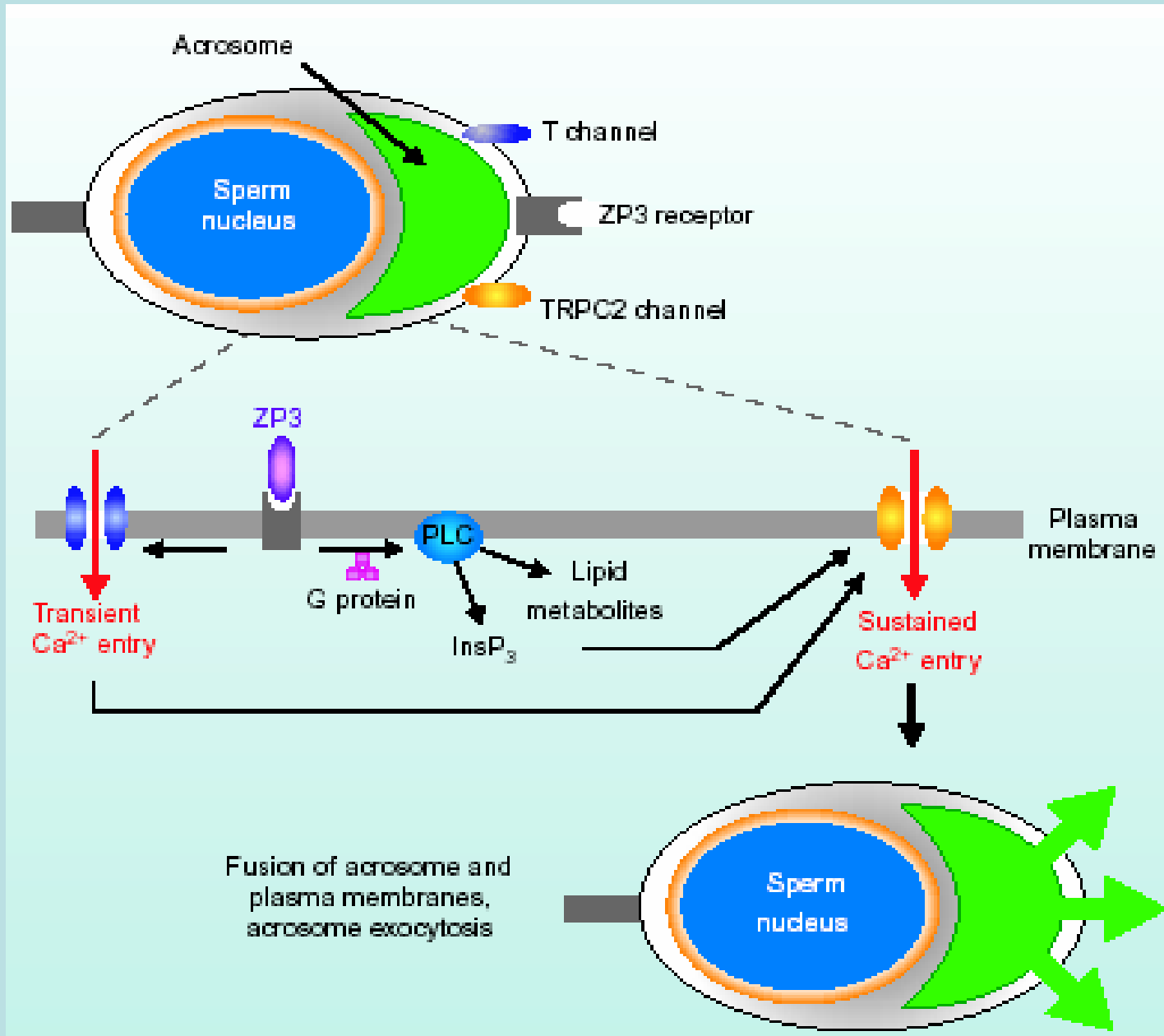
El Acrosoma Como Depósito de Calcio Intraespermático



Eventos Asociados a la Elevación de Calcio Intraespermático Involucrados en el Desarrollo de la RA



Estimulación de eventos de la RA del espermatozoide por acción de ZP3



Interacción Espermatozoide-Oocito e Inducción de la RA

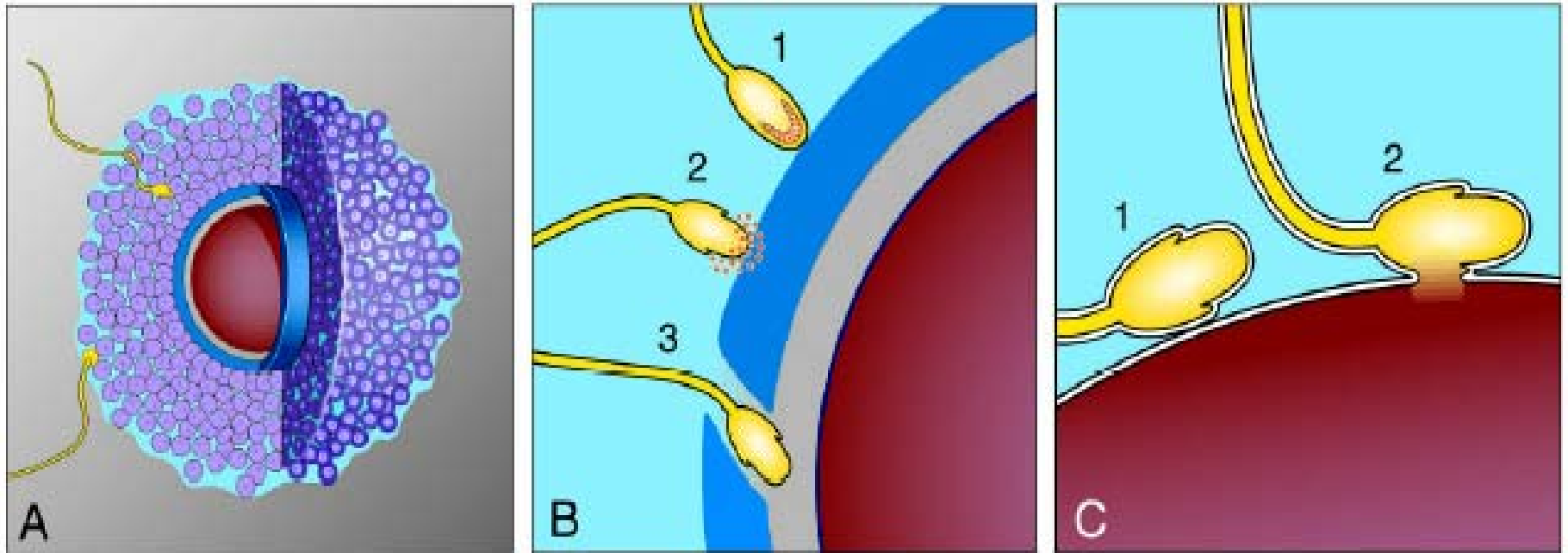
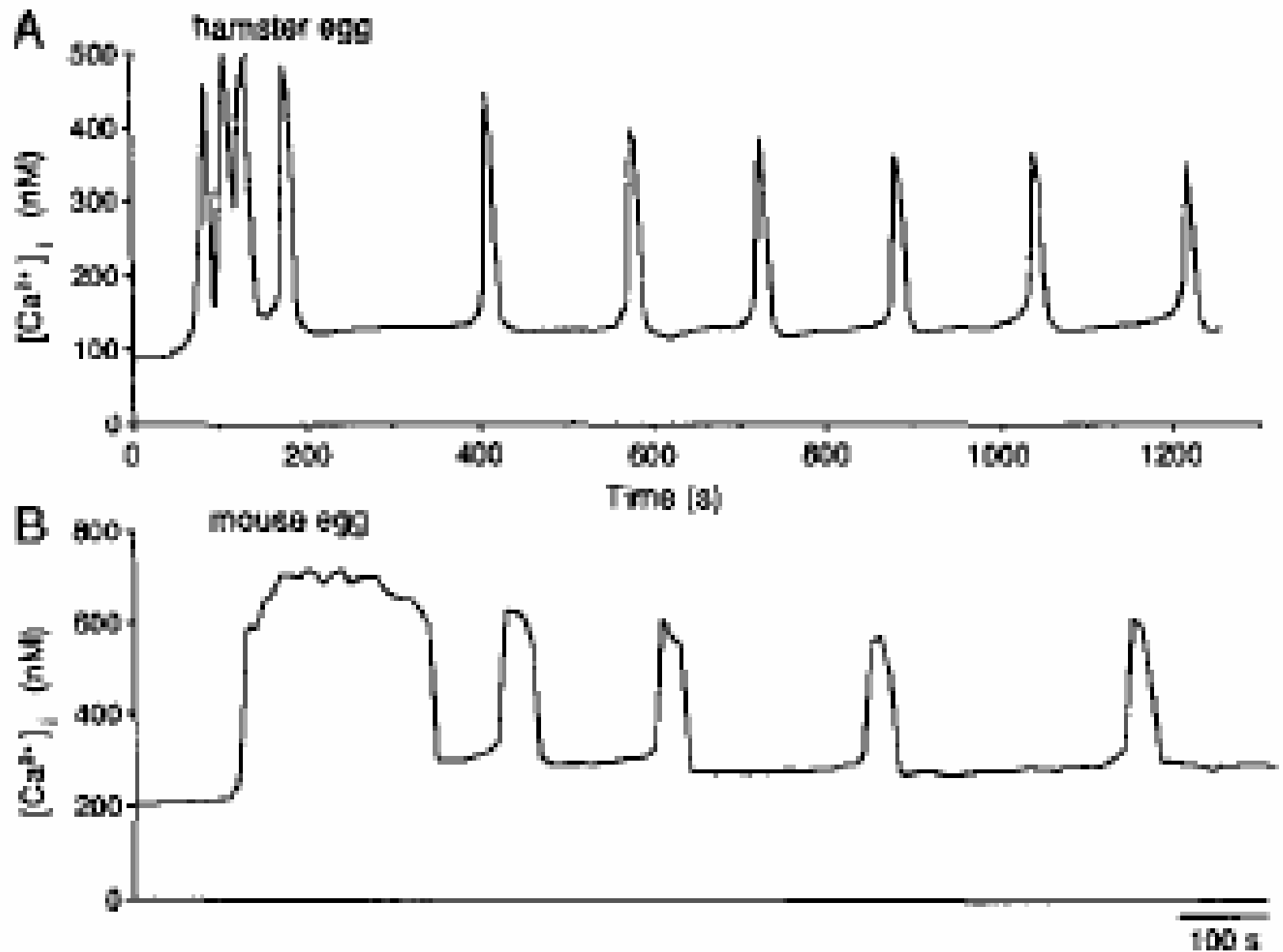


Fig. 1. (A) Sperm penetration of cumulus cells (purple) to reach zona (navy blue). (B) Egg depicted with cumulus cells removed; sperm 1 binds to the zona pellucida (navy blue); sperm 2 undergoes exocytosis, releasing acrosomal contents (orange-red); sperm 3 penetrates the

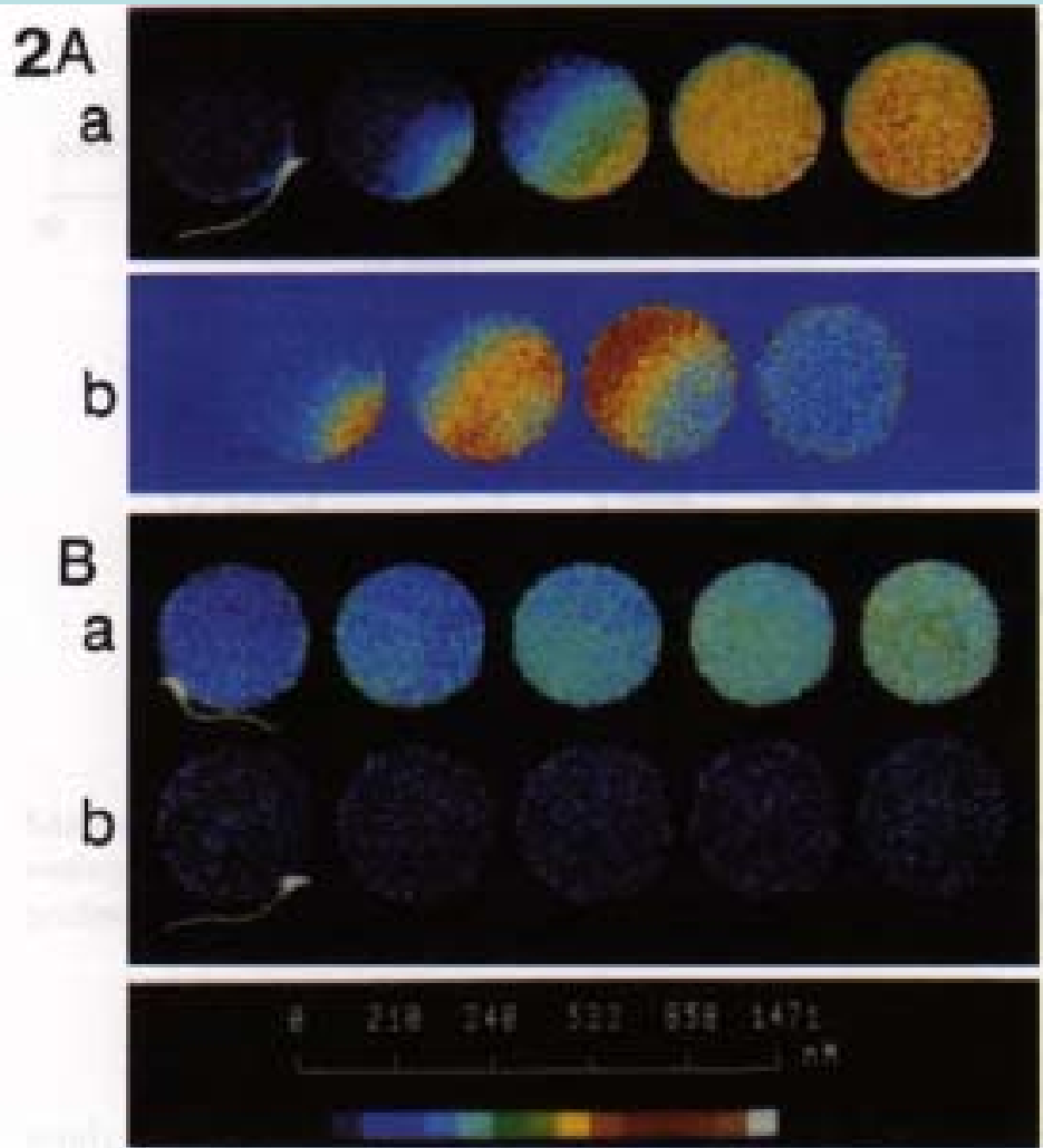
zona pellucida and begins entry into perivitelline space (gray). (C) Sperm 1 binds to the egg plasma membrane by the side of its head, in a central region (equatorial region); sperm 2 fuses with the egg plasma membrane.

Elevaciones transientes de calcio libre citoplasmático en el oocito en la fecundación

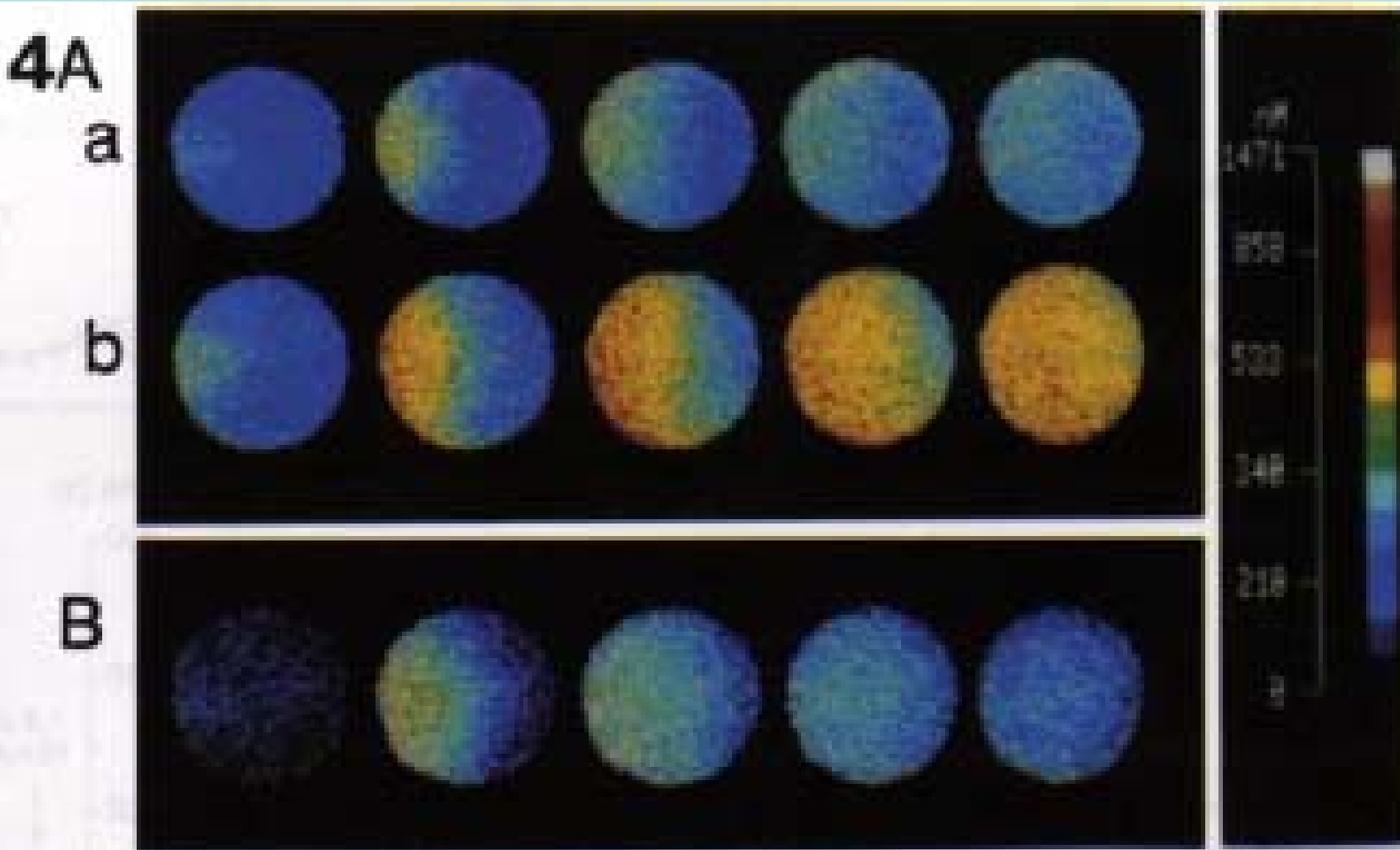




**Ondas de calcio al
contacto de membranas
gaméticas y rol de
receptores para IP3
intraovocitarios**



Ondas de calcio libre intracitoplasmáticas e inyección intraovocitaria de IP3



Moléculas de señalización celular y liberación de calcio en el oocito en la fecundación

TABLE 1
Signaling Components that Mediate Ca^{2+} Release in Eggs at Fertilization

	Echinoderms	Ascidians	Amphibians	Mammals
Inositol trisphosphate ^a	+	+	+	+
Phospholipase $\text{C}\gamma$ ^b	+	+	?	?
Tyrosine kinase ^c	+	+	+	?

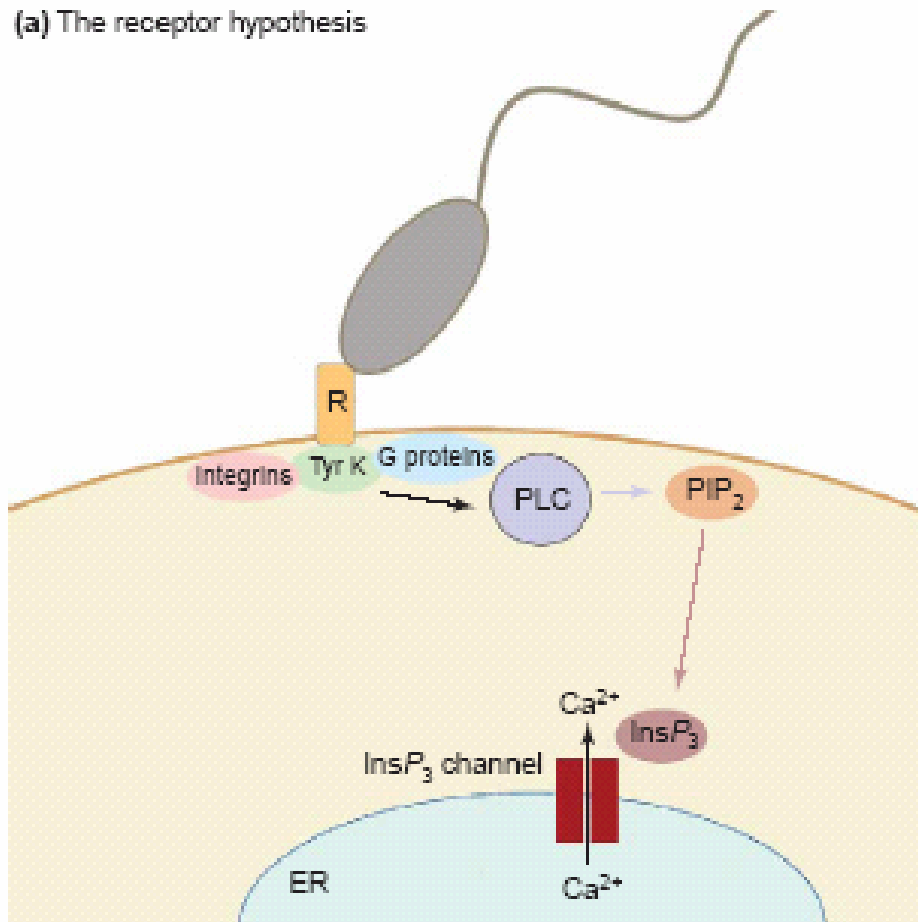
^a Echinoderms: Whitaker and Irvine, 1984; Clapa and Whitaker, 1986; Chiba *et al.*, 1990; Mohri *et al.*, 1995; Carroll *et al.*, 1997, 1999; Lee and Shen, 1998; Shearer *et al.*, 1999; Iwasaki *et al.*, 2001. Ascidians: Toratani and Yokosawa, 1995; Albrieux *et al.*, 1997; Runft *et al.*, 2000. Amphibians: Busa *et al.*, 1985; Stith *et al.*, 1993; Nuccitelli *et al.*, 1993; Snow *et al.*, 1996; Runft and Jaffe, 1999; Yamamoto *et al.*, 2001. Mammals: Miyazaki, 1988; Miyazaki *et al.*, 1992, 1993; Kline and Kline, 1994.

^b Echinoderms: Carroll *et al.*, 1997, 1999; Lee and Shen, 1998; Shearer *et al.*, 1999; Rongish *et al.*, 1999. Ascidians: Runft and Jaffe, 2000. Amphibians: Runft *et al.*, 1999; Sato *et al.*, 2000. Mammals: Dupont *et al.*, 1996; Mehlmann *et al.*, 1998, 2001; Jones *et al.*, 2000.

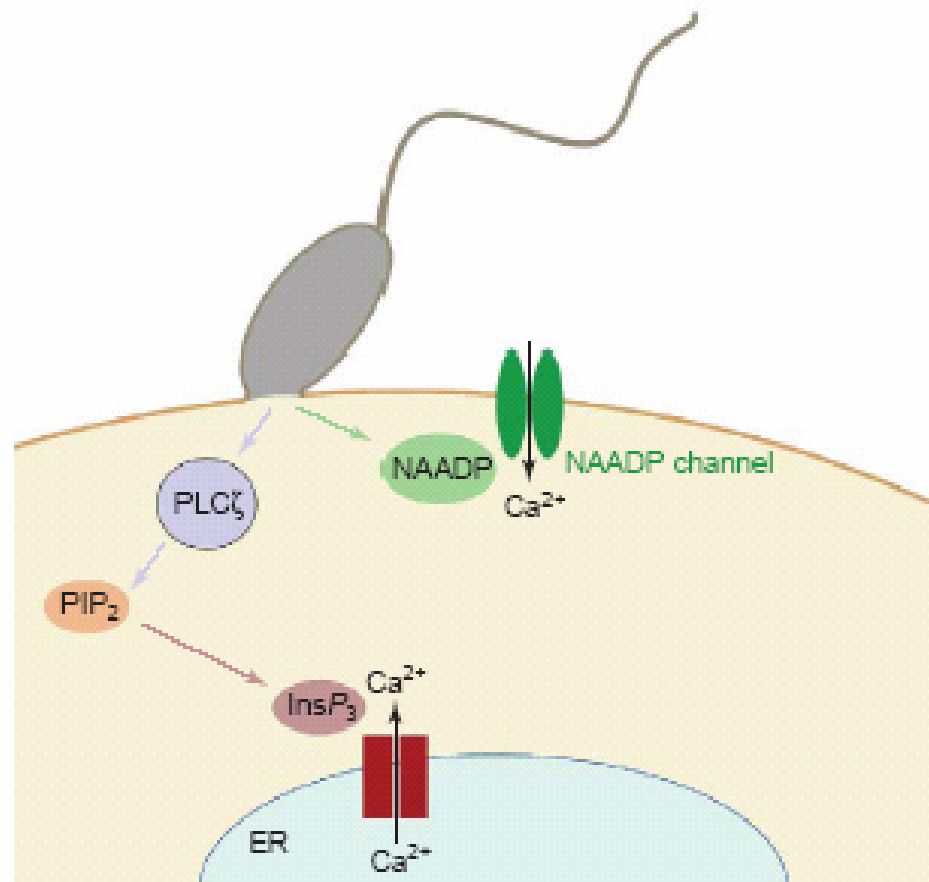
^c Echinoderms: Clapa and Epel, 1991; Shen *et al.*, 1999; Giusti *et al.*, 1999a,b, 2000; Abassi *et al.*, 2000; Kinsey and Shen, 2000. Ascidians: Ueki and Yokosawa, 1997; Runft and Jaffe, 2000. Amphibians: Glahn *et al.*, 1999; K. Sato *et al.*, 1996, 1999, 2000. Mammals: Dupont *et al.*, 1996; Talmor *et al.*, 1998.

Interacción de membranas gaméticas y $[Ca^{2+}]_i$

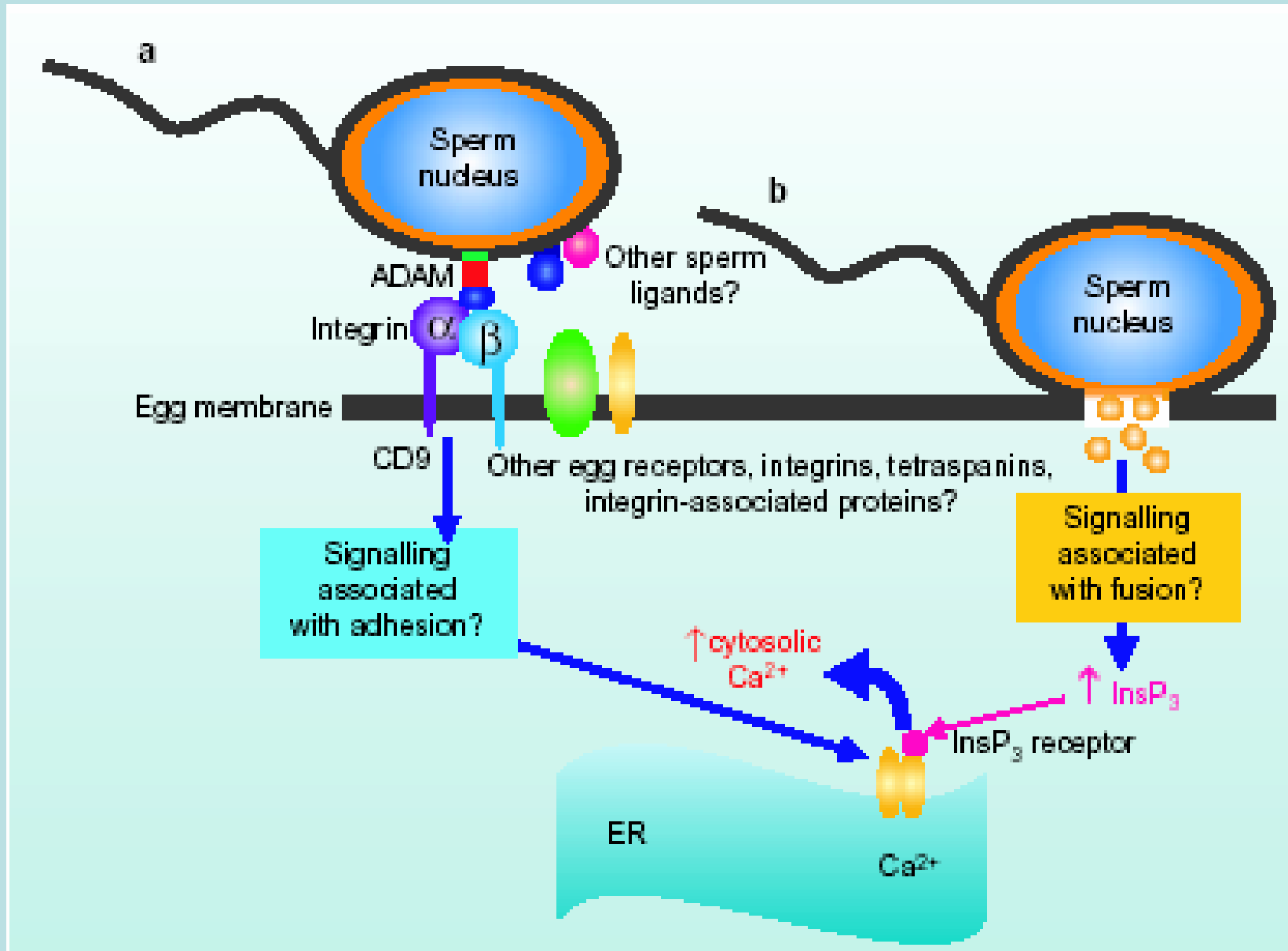
(a) The receptor hypothesis



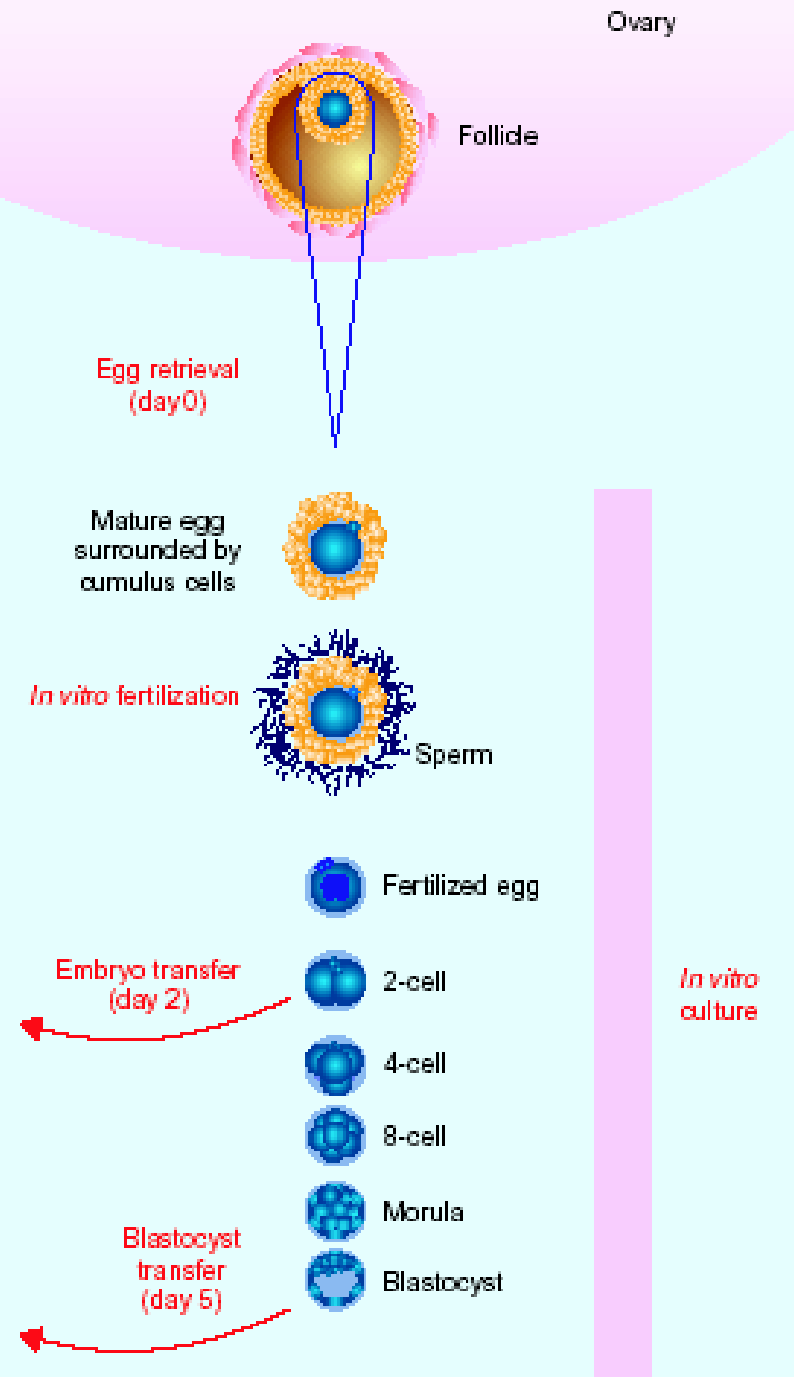
(b) The sperm factor hypothesis



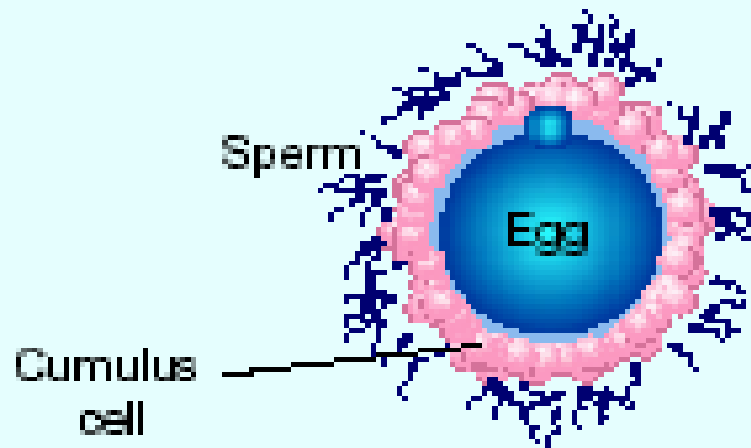
Interacción de membranas gaméticas y activación del oocito



Etapas asociadas a la fecundación in vitro.

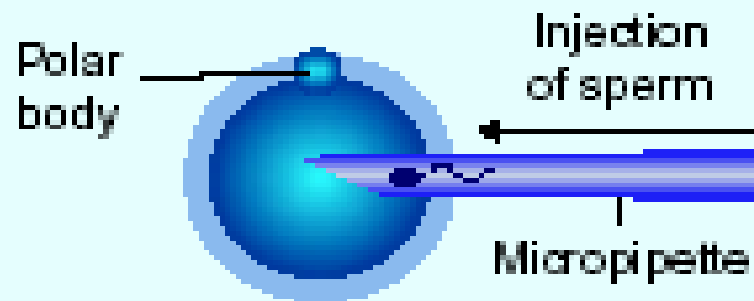


Técnicas utilizadas en reproducción asistida I



Routine practice

In vitro fertilization



Intracytoplasmic sperm injection



Cryopreservation

Técnicas utilizadas en reproducción asistida II

