

8. ABREVIATURAS

AC: adenilato ciclasa.

ADAM: “A *Disintegrin And a Metalloprotease*”.

BSA: albúmina sérica bovina (Bovine Serun Albumine).

BTS: Betswille Thawing Solution.

CASA: “Computer assisted sperm analysis”.

CO: *cumulus oophorus*.

COC's: complejos *cumulus oophorus*-ovocito.

CTC: chlortetraciclina

CHO: “cellular hamster ovary”.

DABCO: 1,4-diacibiciclo-octano.

DAG: diacilglicerol.

dbAMPc : dibutiril adenil monofosfato cíclico.

DCFH-DA: 2',7diclorofluoresceína diacetato.

DTSP: di(N-succinimidil)3,3'-ditiodipropionato Dithiobis(succinimidil propionato).

EPV: espacio perivitelino.

FIV: fecundación *in vitro*.

FO: fluido oviductal

GABA: ácido gamma amino-butírico

Gal T: galactosiltransferasa.

GPI: licosilfosfatidilinositol.

HCG: gonadotropina coriónica humana (Human Corionic Gonadotropin).

HESPA: zona-free hamster egg sperm penetration assay.

HSA: albúmina sérica humana (Human Serun Albumine).

ICSI: microinyección intracitoplasmática.

IP₃: inositoltrifosfato.

MDC: metalloprotease Disintegrin Cysteine-rich.

MIV: maduración *in vitro*.

OCM: medio de recogida de ovocitos (Oocytes Collection Medium).

PBS: tampón fosfato salino de Dulbecco modificado (Phosphate Buffer Saline).

PFF: fluido folicular porcino (Porcine follicular fluid).

PHE: epinefrina-hipotaruina-penicilamina.

PIP₂: fosfoinositol bifosfato.

PLA, PLC, PLD: fosfolipasas A, C, y D.

PMSG: gonadotropina coriónica de yegua gestante (Pregnant Mare Serum Gonadotropin).

PNA: Peanut agglutinin

PSA: Pissum sativum agglutinin

PVA: polivinil alcohol.

RA: reacción acrosómica.

ROS: especies oxígeno reactivas ("reactive oxygen species").

S: segundos

SFB: suero fetal bovino.

SSF: solución salina fisiológica.

SUZI: inyección espermática subzonal.

TALP: medio de Tyrodes con albúmina, lacta y piruvato (Tyrodes Albumin Lactate Pyruvate).

TDP: tiempo de digestión con pronasa

ZP: zona pelúcida.

9. BIBLIOGRAFÍA

- Abeydeera LR (2002). In vitro production of embryos in swine. *Theriogenology* 57:256-273.
- Agarwal A, Allamaneni SSR (2005). Alteraciones de la cromatina espermática en la etiopatogenia de la infertilidad masculina. *Rev Int Androl* 3:31-37.
- Agarwal A, Said TM (2003). Role of sperm chromatin abnormalities and DNA damage in male infertility. *Hum Reprod Update* 9:331-345.
- Ahmadi A, Bongso A, Ng SC (1996). Intracytoplasmic injection of human sperm into the hamster oocyte (hamster ICSI assay) as a test for fertilizing capacity of the severe male-factor sperm. *J Assist Reprod Genet* 13:647-651.
- Ahmadi A, Ng SC (1999). Destruction of protamine in human sperm inhibits sperm binding and penetration in the zona-free hamster penetration test but increases sperm head decondensation and male pronuclear formation in the hamster-ICSI assay. *J Assist Reprod Genet* 16:128-132.
- Aitken RJ, Thatcher S, Glasier AF, Clarkson JS, Wu FC, Baird DT (1987). Relative ability of modified versions of the hamster oocyte penetration test, incorporating hyperosmotic medium or the ionophore A23187, to predict IVF outcome. *Hum Reprod* 2:227-231.
- Aitken RJ, Clarkson JS, Fishel S (1989). Generation of reactive oxygen species, lipid peroxidation, and human sperm function. *Biol Reprod* 41:183-197.
- Aitken RJ, Irvine DS, Wu FC (1991). Prospective analysis of sperm-oocyte fusion and reactive oxygen species generation as criteria for the diagnosis of infertility. *Am J Obstet Gynecol* 164:542-551.
- Aitken RJ (1997). Molecular mechanisms regulating human sperm function. *Mol Hum Reprod* 3:169-173.
- Aitken RJ (2006). Sperm function tests and fertility. *Int J Androl* 29:69-75. .
- Alfieri JA, Martin AD, Takeda J, Kondoh G, Myles DG, Primakoff P (2003). Infertility in female mice with an oocyte-specific knockout of GPI-anchored proteins. *J Cell Sci* 116:2149-2155.
- Amari S, Yonezawa N, Mitsui S, Katsumata T, Hamano S, Kuwayama M, Hashimoto Y, Suzuki A, Takeda Y, Nakano M (2001). Essential role of the nonreducing terminal alpha-mannosyl residues of the N-linked carbohydrate chain of bovine zona pellucida glycoproteins in sperm-egg binding. *Mol Reprod Dev* 59:221-226.
- Amin AH, Bailey JL, Storey BT, Blasco L, Heyner S (1996). A comparison of three methods for detecting the acrosome reaction in human spermatozoa. *Hum Reprod* 11:741-745.
- Anderson RA, Feathergill KA, Waller DP, Zaneveld LJ (2006). SAMMA induces premature human acrosomal loss by Ca²⁺ signaling dysregulation. *J Androl* 27:568-577.
- Austin CR (1951). Observations on the penetration of the sperm in the mammalian egg. *Aust J Sci Res* 4:581-596.
- Austin CR (1952). The "capacitation" of the mammalian sperm. *Nature* 170:326.
- Austin CR, Braden AW (1956) Early reaction of the rodent egg to spermatozoon penetration. *J Exp Biol* 33:358-365.
- Aviles M, Martinez-Menarguez JA, Castells MT, Madrid JF, Ballesta J (1994). Cytochemical characterization of oligosaccharide side chains of the glycoproteins of rat zona pellucida: an ultrastructural study. *Anat Rec* 239:137-149.
- Aviles M, Abasacal I, Martinez-Menarguez JA, Castells MT, Skalaban SR, Ballesta J, Alhadeff JA (1996). Immunocytochemical localization and biochemical characterization of a novel plasma

membrane-associated, neutral pH optimum α L-fucosidase from rat testis and epididymal spermatozoa. *Biochem J* 318: 821-831.

Aviles M, Jaber L, Castells MT, Ballesta J, Kan FW (1997). Modifications of carbohydrate residues and ZP2 and ZP3 glycoproteins in the mouse zona pellucida after fertilization. *Biol Reprod* 57:1155-1163.

Aviles M, Castells MT, Abascal I, Martinez-Menarguez JA, Draber P, Kan FW, Ballesta J (1999). Cytochemical localization of GalNAc and GalNAc β 1,4Gal β 1,4 disaccharide in mouse zona pellucida. *Cell Tissue Res* 295:269-277.

Aviles M, Okinaga T, Shur BD, Ballesta J (2000). Differential expression of glycoside residues in the mammalian zona pellucida. *Mol Reprod Dev* 57:296-308.

Avrech O, Fisch B, Shalgi R (1997). Acrosomal status of human spermatozoa after follicular fluid or calcium ionophore challenge in relation to semen parameters and fertilizing capacity in vitro. *Andrologia* 29:97-101.

Ballachey BE, Evenson DP, Saacke RG (1988). The sperm chromatin structure assay. Relationship with alternate tests of semen quality and heterospermic performance of bulls. *J Androl* 9:109-115.

Barratt CL, Osborn JC, Harrison PE, Monks N, Dunphy BC, Lenton EA, Cooke ID (1989). The hypo-osmotic swelling test and the sperm mucus penetration test in determining fertilization of the human oocyte. *Hum Reprod* 4:430-444.

Barros C, Yanagimachi R (1972). Polyspermy-preventing mechanisms in the golden hamster egg. *J Exp Zool* 180:251-265.

Bastiaan HS, Menkveld R, Oehninger S, Franken DR (2002). Zona pellucida induced acrosome reaction, sperm morphology, and sperm-zona binding assessments among subfertile men. *J Assist Reprod Genet* 19:329-334.

Bastiaan HS, Windt ML, Menkveld R, Kruger TF, Oehninger S, Franken DR (2003). Relationship between zona pellucida-induced acrosome reaction, sperm morphology, sperm-zona pellucida binding, and in vitro fertilization. *Fertil Steril* 79:49-55.

Bastiaan H, Franken D (2007). The influence of homogenous zona pellucida on human spermatozoa hyperactivation, acrosome reaction and zona binding. *Andrologia* 39:7-11.

Bedford JM (1977). Sperm/egg interaction: the specificity of human spermatozoa. *Anat Rec* 188:477-87.

Bedford JM, Moore HDM, Franklin LE (1979). Significance of the equatorial segment of the acrosome of the spermatozoon in eutherian mammals. *Exp Cell Res* 119:119-126.

Bedford JM (1998). Mammalian fertilization misread? Sperm penetration of the eutherian zona pellucida is unlikely to be a lytic event. *Biol Reprod* 59:1275-1287.

Benoff S, Hurley I, Cooper GW, Mandel FS, Hershlag A, Scholl GM, Rosenfeld DL (1993). Fertilization potential in vitro is correlated with head-specific mannose-ligand receptor expression, acrosome status and membrane cholesterol content. *Hum Reprod* 8:2155-2166.

Benoff S (1997). Carbohydrates and fertilization: an overview. *Mol Hum Reprod* 3:599-637.

Ben-Yosef D, Shalgi R (2001). Oocyte activation: lessons from human infertility. *Trends Mol Med* 7:163-169.

Berger T, Horton MB (1988). Evaluation of assay conditions for the zona-free hamster ova bioassay of boar sperm fertility. *Gamete Res* 19:101-11.

- Berger T (1989). Development of a zona-free hamster ova bioassay for goat sperm. *Theriogenology* 32:69-77.
- Berger T, Davis A, Wardrip NJ, Hedrick JL (1989). Sperm binding to the pig zona pellucida and inhibition of binding by solubilized components of the zona pellucida. *J Reprod Fertil* 86:559-565.
- Bergqvist AS, Ballester J, Johannisson A, Hernandez M, Lundeheim N, Rodriguez-Martinez H (2006). In vitro capacitation of bull spermatozoa by oviductal fluid and its components. *Zygote* 14:259-273.
- Berridge MJ, Irvine RF (1989). Inositol phosphates and cell signalling. *Nature* 341:197-205.
- Betteridge KJ (2006). Farm animal embryo technologies: achievements and perspectives. *Theriogenology* 65:905-913.
- Berridge MJ (1997). Elementary and global aspects of calcium signalling. *J Exp Biol* 200:315-319.
- Bielanski A, Lutze-Wallace CL, Nadin-Davis S (2003). Adherence of bovine viral diarrhoea virus to bovine oocytes and embryos with a hardened zona pellucida cultured in vitro. *Can J Vet Res* 67:48-51.
- Bigler D, Takahashi Y, Chen MS, Almeida EA, Osbourne K, White JM (2000). Sequence-specific interaction between the disintegrin domain of mouse ADAM 2 (fertilin β) ymurine eggs. Role of the α_6 integrin subunit. *J Biol Chem* 275:11576.
- Bleil JD, Wassarman PM (1980). Mammalian sperm-egg interaction: identification of a glycoprotein in mouse egg zonae pellucidae possessing receptor activity for sperm. *Cell* 20:873-882.
- Bleil JD, Wassarman PM (1986). Autoradiographic visualization of the mouse egg's sperm receptor bound to sperm. *J Cell Biol* 102:1363-1371.
- Bleil JD, Wassarman PM (1990). Identification of a ZP3-binding protein on acrosome-intact mouse sperm by photoaffinity crosslinking. *PNAS USA* 87:5563-5567.
- Blobel CP, Wolfsberg TG, Turck CW, Myles DG, Primakoff P, White JM (1992). A potential fusion peptide and an integrin ligand domain in a protein active in sperm-egg fusion. *Nature* 356:248-252.
- Boettger-Tong HL, Aarons DJ, Biegler BE, George B, Poirier GR (1993). Binding of a murine proteinase inhibitor to the acrosome region of the human sperm head. *Mol Reprod Dev* 36:346-353.
- Boice ML, Geisert RD, Blair RM, Verhage HG (1990). Identification and characterization of bovine oviductal glycoproteins synthesized at estrus. *Biol Reprod* 43:457-465.
- Boja ES, Hoodbhoy T, Fales HM, Dean J (2003). Structural characterization of native mouse zona pellucida proteins using mass spectrometry. *J Biol Chem* 278:34189-34202.
- Bousquet D, Brackett BG (1982). Penetration of zona-free hamster ova as a test to assess fertilizing ability of bull sperm after frozen storage. *Theriogenology* 17:199-213.
- Bray C, Son JH, Kumar P, Harris JD, Meizel S (2002). A role for the human sperm glycine receptor/Cl(-) channel in the acrosome reaction initiated by recombinant ZP3. *Biol Reprod* 66:91-97.
- Breitbart H, Rubinstein S, Lax Y (1997). Regulatory mechanisms in acrosomal exocytosis. *Rev Reprod* 2:165-174.
- Breitbart H (2002). Intracellular calcium regulation in sperm capacitation and acrosomal reaction. *Mol Cell Endocrinol* 22:139-144.
- Breitbart H, Cohen G, Rubinstein S (2005). Role of actin cytoskeleton in mammalian sperm capacitation and the acrosome reaction. *Reproduction* 129:263-268.

- Brewis IA, Clayton R, Barratt CL, Hornby DP, Moore HD (1996). Recombinant human zona pellucida glycoprotein 3 induces calcium influx and acrosome reaction in human spermatozoa. *Mol Hum Reprod* 2:583-589.
- Brewis IA, Morton IE, Moore HD, England GC (2001). Solubilized zona pellucida proteins and progesterone induce calcium influx and the acrosome reaction in capacitated dog spermatozoa. *Mol Reprod* 60:491-497.
- Broermann DM, Xie S, Nephew KP, Pope WF (1989). Effects of the oviduct and wheat germ agglutinin on enzymatic digestion of porcine zona pellucidae. *J Anim Sci* 67:1324-1329.
- Brown CR, Cheng WK (1986). Changes in composition of the porcine zona pellucida during development of the oocyte to the 2- to 4-cell embryo. *J Embryol Exp Morphol* 92:183-191.
- Buhi WC, Ashworth CJ, Bazer FW, Alvarez IM (1992). In vitro synthesis of oviductal secretory proteins by estrogen-treated ovariectomized gilts. *J Exp Zool* 262:426-435.
- Buhi WC, O'Brien B, Alvarez IM, Erdos G, Dubois D (1993). Immunogold localization of porcine oviductal secretory proteins within the zona pellucida, perivitelline space, and plasma membrane of oviductal and uterine oocytes and early embryos. *Biol Reprod* 48:1274-1283.
- Buhi WC, Alvarez IM, Kouba AJ (1997). Oviductal regulation of fertilization and early embryonic development. *J Reprod Fertil Suppl* 52:285-300.
- Buhi WC, Alvarez IM, Kouba AJ (2000). Secreted proteins of the oviduct. *Cells Tissues Organs* 166:165-179.
- Buhi WC (2002). Characterization and biological roles of oviduct-specific, oestrogen-dependent glycoprotein. *Reproduction* 123:355-362.
- Bungum M, Humaidan P, Spano M, Jepson K, Bungum L, Giwercman A (2004). The predictive value of sperm chromatin structure assay (SCSA) parameters for the outcome of intrauterine insemination, IVF and ICSI. *Hum Reprod* 19:1401-1408.
- Burgoyne RD, Morgan A (1995). Ca²⁺ and secretory-vesicle dynamics. *Trends Neurosci* 18:191-196.
- Burkman LJ, Coddington CC, Franken DR, Krugen TF, Rosenwaks Z, Hogen GD (1988). The hemizona assay (HZA): development of a diagnostic test for the binding of human spermatozoa to the human hemizona pellucida to predict fertilization potential. *Fertil Steril* 49:688-697.
- Calvo L, Vantman D, Banks SM, Tezon J, Koukoulis GN, Dennison L, Sherins RJ (1989). Follicular fluid-induced acrosome reaction distinguishes a subgroup of men with unexplained infertility not identified by semen analysis. *Fertil Steril* 52:1048-1054.
- Camaioni A, Salustri A, Yanagishita M, Hascall V (1996). Proteoglycans and proteins in the extracellular matrix of mouse cumulus cell-oocyte complexes. *Arch Biochem Biophys* 325:190-198.
- Carlson AE, Westenbroek RE, Quill T, Ren D, Clapham DE, Hille B, Garbers DL, Babcock DF (2003). CatSper1 required for evoked Ca²⁺ entry and control of flagellar function in sperm. *PNAS* 100:14864-14868.
- Carrasco LC, Romar R, Aviles M, Coy P (2007). Enzymatic activity level of different glycosidases in bovine oviductal fluid at different stages of the estrous cycle. 33rd Annual Conference of the International Embryo Transfer Society (IETS), Kyoto (Japan). *Reproduction, Fertility and Development*.
- Chakravarty S, Suraj K, Gupta S (2005). Baculovirus-expressed recombinant human zona pellucida glycoprotein-B induces acrosomal exocytosis in capacitated spermatozoa in addition to zona pellucida glycoprotein-C. *Mol Hum Reprod* 11:365-3672.

- Chang MC (1951). Fertilizing capacity of spermatozoa deposited into fallopian tubes. *Nature* 168:697-698.
- Chen L, Zhang H, Powers RW, Russell PT, Larsen WJ (1996). Covalent link-age between proteins of the inter- α -inhibitor family yhyaluronic acid is mediated by a factor produced by granulosa cells. *J Biol Chem* 271:19409-19414.
- Chen MS, Tung KS, Coonrod SA, Takahashi Y, Bigler D, Chang A, Yamashita Y, Kincade PW, Herr JC, White JM (1999). Role of the integrin-associated protein CD9 in binding between sperm ADAM 2 and the egg integrin $\alpha 6 \beta 1$: implications for murine fertilization. *PNAS* 96:11830-11835.
- Chen XY, Li QW, Zhang SS, Han ZS, Zhao R, Wu SY, Huang J (2006). Effects of ovarian cortex cell co-culture during in vitro maturation on porcine oocytes maturation, fertilization and embryo development. *Anim Reprod Sci.* Jun 16;
- Cheng A, Le T, Palacios M, Bookbinder LH, Wassarman PM, Suzuki F, Bleil JD (1994). Sperm-egg recognition in the mouse: characterization of sp56, a sperm protein having specific affinity for ZP3. *J Cell Biol* 125:867-78.
- Cherr GN, Lambert H, Meizel S, Katz DF (1986). In vitro studies of the golden hamster sperm acrosome reaction: completion on the zona pellucida and induction by homologous soluble zonae pellucidae. *Dev Biol* 114:119-131.
- Cho C, Bunch DO, Faure JE, Goulding EH, Eddy EM, Primakoff P, Myles DG (1998). Fertilization defects in sperm from mice lacking fertilin beta. *Science* 281:1857-1859.
- Choudhry TM, Berger T, Dally M (1995). In vitro fertility evaluation of cryopreserved ram semen and its correlation with relative in vivo fertility. *Theriogenology* 43:1195-1200.
- Clark GF, Dell A (2006). Molecular models for murine sperm-egg binding. *J Biol Chem* 281:13853-13856.
- Cohen DJ, Ellerman DA, Cuasnicu PS (2000). Mammalian sperm-egg fusion: evidence that epididymal protein DE plays a role in mouse gamete fusion. *Biol Reprod* 63:462-468.
- Conley AJ, Howard HJ, Slanger WD, Ford JJ (1994). Steroidogenesis in the preovulatory porcine follicle. *Biol Reprod* 51:655-61.
- Cook SP, Brokaw CHA, Muller CH, Babcock D (1994). Sperm chemotaxis: egg peptides control cytosolic calcium to regulate flagellar responses. *Dev Biol* 165:10-19.
- Coy P, Gadea J, Romar R, Matas C, Garcia E (2002). Effect of in vitro fertilization medium on the acrosome reaction, cortical reaction, zona pellucida hardening and in vitro development in pigs. *Reproduction* 124:279-288.
- Coy P, Romar R (2002). In vitro production of pig embryos: a point of view. *Reprod Fertil Dev* 14:275-86.
- Coy P, Romar R, Payton RR, McCann L, Saxton AM, Edwards JL (2005a). Maintenance of meiotic arrest in bovine oocytes using the S-enantiomer of roscovitine: effects on maturation, fertilization and subsequent embryo development in vitro. *Reproduction* 129:19-26.
- Coy P, Romar R, Ruiz S, Canovas S, Gadea J, Garcia Vazquez F, Matas C (2005b). Birth of piglets after transferring of in vitro-produced embryos pre-matured with R-roscovitine. *Reproduction* 129:747-755.
- Cross NL, Morales P, Overstreet JW, Hanson FW (1988). Induction of acrosome reactions by the human zona pellucida. *Biol Reprod* 38:235-244.
- Cross NL, Hanks SE (1991). Effects of cryopreservation on human sperm acrosomes. *Hum Reprod* 6:1279-1283.

- Cross NL (1998). Role of cholesterol in sperm capacitation. *Biol Reprod* 59:7-11.
- Cuasnicu PS, Ellerman DA, Cohen DJ, Busso D, Morgenfeld MM, Da Ros VG (2001). Molecular mechanisms involved in mammalian gamete fusion. *Arch Med Res* 32:614-618.
- Cummins JM, Pember SM, Jequier AM, Yovich JL, Hartmann PE (1991). A test of the human sperm acrosome reaction following ionophore challenge. Relationship to fertility and other seminal parameters. *J Androl* 12:98-103.
- D'Cruz OJ, Haas GG (1993). The expression of the complement regulators CD46, CD55, and CD59 by human sperm does not protect them from antisperm antibody- and complement-mediated immune injury. *Fertil Steril* 59:876-884.
- De Jonge CJ, Barratt CL, Radwanska E, Cooke ID (1993). The acrosome reaction-inducing effect of human follicular and oviductal fluid. *J Androl* 14:359-365.
- de Lamirande E, Gagnon C (1995). Impact of reactive oxygen species on spermatozoa: a balancing act between beneficial and detrimental effects. *Hum Reprod* 10 Suppl 1:15-21.
- de Lamirande E, Leclerc P, Gagnon C (1997). Capacitation as a regulatory event that primes spermatozoa for the acrosome reaction and fertilization. *Mol Hum Reprod* 3:175-194.
- Dean J (2004). Reassessing the molecular biology of sperm-egg recognition with mouse genetics. *Bioessays* 26:29-38.
- Dell A, Chalabi S, Easton RL, Haslam SM, Sutton-Smith M, Patankar MS, Lattanzio F, Panico M, Morris HR, Clark GF (2003). Murine and human zona pellucida 3 derived from mouse eggs express identical O-glycans. *PNAS* 100:15631-15636.
- Delle Monache S, Flori F, Della Giovampaola C, Capone A, La Sala GB, Rosati F, Colonna R, Tatone C, Focarelli R (2003). Gp273, the ligand molecule for sperm-egg interaction in the bivalve mollusk, *Unio elongatulus*, binds to and induces acrosome reaction in human spermatozoa through a protein kinase C-dependent pathway. *Biol Reprod* 69:1779-1784.
- DeMott RP, Lefebvre R, Suarez SS (1995). Carbohydrates mediate the adherence of hamster sperm to oviductal epithelium. *Biol Reprod* 52:1395-1403.
- Dimitriadou F, Rizos D, Mantzavinos T, Arvaniti K, Voutsina K, Prapa A, Kanakas N (1995). The effect of pentoxifylline on sperm motility, oocyte fertilization, embryo quality, and pregnancy outcome in an in vitro fertilization program. *Fertil Steril* 63:880-886.
- Ducibella T, Duffy P, Buetow J (1994). Quantification and localization of cortical granules during oogenesis in the mouse. *Biol Reprod* 50:467-473.
- Ducibella T, Dubey A, Gross V, Emmi A, Penzias A, Layman L, Reindollar R (1995). A zona biochemical change and spontaneous cortical granule loss in eggs that fail to fertilize in vitro fertilization *Fert Steril* 64:1154-1161.
- Dunbar BS, Wolgemuth DO (1984). Structure and function of the mammalian zona pellucida, a unique extracellular matrix. En: *Modern Cell Biology*, Volumen 3. B.H. Satir, (edit) New York: Alan R. Liss, Inc., pags. 77-111.
- Dunbar BS, Avery S, Lee V, Prasad S, Schwahn D, Schwoebel D, Skinner S, Wilkins B (1994). The mammalian zona pellucida: its biochemistry, immunochemistry, molecular biology, and developmental expression. *Reprod Fert Dev* 6:331-347.
- Eberspaecher U, Barros C (1984). Changes at the hamster oocyte surface from the germinal vesicle stage to ovulation. *Gamete Res* 9:387-397.
- Edwards JL, Hansen PJ (1996). Elevated temperature increases heat shock protein 70 synthesis in bovine two-cell embryos and compromises function of maturing oocytes. *Biol Reprod* 55:341-346.

- Emiliozzi C, Cordonier H, Guerin JF, Ciapa B, Benchaib M, Fenichel P (1996). Effects of progesterone on human spermatozoa prepared for in-vitro fertilization. *Int J Androl* 19:39-47.
- Ensslin MA, Shur BD (2003). Identification of mouse sperm SED1, a bimotif EGF repeat and discoidin-domain protein involved in sperm-egg binding. *Cell* 114:405-417.
- Esterhuizen AD, Franken DR, Lourens JGH, Van Rooyen LH (2001) Clinical importance of zona pellucida induced acrosome reaction (ZIAR test) in cases of failed human fertilization. *Hum Reprod* 16:138–144.
- Evans JP (1999). Sperm disintegrins, egg integrins, and other cell adhesion molecules of mammalian gamete plasma membrane interactions. *Frontiers in Bioscience* 4:114-131.
- Evans JP (2001). Fertilin beta and other ADAMs as integrin ligands: insights into cell adhesion and fertilization. *Bioessays* 23:628-639.
- Evans JP (2002). The molecular basis of sperm-oocyte membrane interactions during mammalian fertilization. *Human Reproduction Update* 8:297-311.
- Evenson DP, Darzynkiewicz Z, Melamed MR (1980). Relation of mammalian sperm chromatin heterogeneity to fertility. *Science* 210:1131-1133.
- Evenson DP, Thompson L, Jost L (1994). Flow cytometric evaluation of boar semen by the sperm chromatin structure assay as related to cryopreservation and fertility. *Theriogenology* 41:637-651.
- Evenson DP, Jost LK, Marshall D, Zinaman MJ, Clegg E, Purvis K, de Angelis P, Claussen OP (1999). Utility of the sperm chromatin structure assay as a diagnostic and prognostic tool in the human fertility clinic. *Hum Reprod* 14:1039-1049.
- Familiari G, Relucenti M, Heyn R, Micara G, Correr S (2006). Three-dimensional structure of the zona pellucida at ovulation. *Microsc Res Tech*.69:415-26.
- Fazeli AR, Steenweg W, Bevers MM, de Loos FA, van den Broek J, Colenbrander B (1993). Development of a sperm zona pellucida binding assay for bull semen. *Vet Rec* 132:14-16.
- Fazeli AR, Steenweg W, Bevers MM, van den Broek J, Bracher V, Parlevliet J, Colenbrander B (1995). Relation between stallion sperm binding to homologous hemizonae and fertility. *Theriogenology* 44:751-760.
- Fazeli A, Hage WJ, Cheng FP, Voorhout WF, Marks A, Bevers MM, Colenbrander B (1997). Acrosome-intact boar spermatozoa initiate binding to the homologous zona pellucida in vitro. *Biol Reprod* 56:430-438.
- Fenichel P, Hsi BL, Farahifar D, Donzeau M, Barrier-Delpech D, Yehy CJ (1989). Evaluation of the human sperm acrosome reaction using a monoclonal antibody, GB24, and fluorescence-activated cell sorter. *J Reprod Fertil* 87:699-706.
- Fenichel P, Donzeau M, Farahifar D, Basteris B, Ayraud N, Hsi BL (1991). Dynamics of human sperm acrosome reaction: relation with in vitro fertilization. *Fertil Steril* 55:994-999.
- First NL, Parrish JJ (1987). In-vitro fertilization of ruminants. *J Reprod Fertil Suppl* 34:151-165.
- Florman HM, Wassarman PM (1985). O-linked oligosaccharides of mouse egg ZP3 account for its sperm receptor activity. *Cell* 41:313-324.
- Florman H, Ducibella T (2006). Fertilization in mammals. In: Neill JD (ed.), *Knobil and Neill's Physiology of Reproduction*. London: Elsevier; 2006: 55-112.
- Focarelli R, Capone A, Ermini L, Del Buono F, Battista La Sala G, Balasini M, Rosati F (2003). Immunoglobulins against gp273, the ligand for sperm-egg interaction in the mollusc bivalve *Unio elongatulus*, are directed against charged O-linked oligosaccharide chains bearing a Lewis-like structure and interact with epitopes of the human zona pellucida. *Mol Reprod Dev* 64:226-234.

- Foerder CA, Shapiro BM (1977). Release of ovoperoxidase from sea urchin eggs hardens the fertilization membrane with tyrosine crosslinks. *PNAS* 74:4214-4218.
- Franken DR, Kruger TF, Menkveld R, Oehninger S, Coddington CC, Hodgen GD (1990). Hemizona assay and teratozoospermia: increasing sperm insemination concentrations to enhance zona pellucida binding. *Fertil Steril* 54:497-503.
- Franken DR, Bastiaan HS, Oehninger SC (2000). Physiological induction of the acrosome reaction in human sperm: validation of a microassay using minimal volumes of solubilized, homologous zona pellucida. *J Assist Reprod Genet* 17:156-161.
- Fraser LR (1992). Requirements for successful mammalian sperm capacitation and fertilization. *Arch Pathol Lab Med* 116:345-350.
- Fraser LR (1995). Cellular biology of capacitation and the acrosome reaction. *Hum Reprod* 10 Suppl 1:22-30.
- Fraser LR, Abeydeera LR, Niwa K (1995). (Ca^{2+})-regulating mechanisms that modulate bull sperm capacitation and acrosomal exocytosis as determined by chlortetracycline analysis. *Mol Reprod Dev* 40:233-241.
- Fraser LR (1998). Sperm capacitation and the acrosome reaction. *Hum Reprod* 13 Suppl 1:9-19.
- Fraser L, Adeoya-Osiguwa S, Baxendale R, Gibbons R (2006). Regulation of mammalian sperm capacitation by endogenous molecules. *Front Biosci* 11:1636-45.
- Funahashi H, Day BN (1993). Effects of follicular fluid at fertilization in vitro on sperm penetration in pig oocytes. *J Reprod Fertil* 99:97-103.
- Funahashi H, Cantley TC, Day BN (1997). Synchronization of meiosis in porcine oocytes by exposure to dibutyryl cyclic AMP improves developmental competence following in vitro fertilization. *Biol Reprod* 57:49-53.
- Funahashi H, Ekwall H, Rodriguez-Martinez H (2000). Zona reaction in porcine oocytes fertilized in vivo and *in vitro* as seen with scanning electron microscopy. *Biol Reprod* 63:1437-1442.
- Funahashi H (2003). Polyspermic penetration in porcine IVM-IVF systems. *Reprod Fertil Dev* 15:167-177.
- Funahashi H, Romar R (2004). Reduction of the incidence of polyspermic penetration into porcine oocytes by pretreatment of fresh spermatozoa with adenosine and a transient co-incubation of the gametes with caffeine. *Reproduction* 128:789-800.
- Gaddum-Rosse P (1985). Mammalian gamete interactions: what can be gained from observations on living eggs?. *Am J Anat* 174:347-356.
- Gadea J, Matas C (2000). Sperm factors related to in vitro penetration of porcine oocytes. *Theriogenology* 54:1343-1357.
- Gadea J, Gumbao D, Matas C, Romar R (2005). Supplementation of the thawing media with reduced glutathione improves function and the in vitro fertilizing ability of boar spermatozoa after cryopreservation. *J Androl* 26:749-756.
- Gandini L, Lombardo F, Paoli D, Caruso F, Eleuteri P, Leter G, Ciriminna R, Culasso F, Dondero F, Lenzi A, Spano M (2004). Full-term pregnancies achieved with ICSI despite high levels of sperm chromatin damage. *Hum Reprod* 19:1409-1417.
- Garcia-Rosello E, Matas C, Canovas S, Moreira PN, Gadea J, Coy P (2006). Influence of sperm pretreatment on the efficiency of intracytoplasmic sperm injection in pigs. *J Androl* 27:268-275.
- Gardner AJ, Evans JP (2006). Mammalian membrane block to polyspermy: new insights into how mammalian eggs prevent fertilisation by multiple sperm. *Reprod Fertil Dev* 18:53-61.

- Gardner AJ, Williams CJ, Evans JP (2007). Establishment of the mammalian membrane block to polyspermy: evidence for calcium-dependent and -independent regulation. *Reproduction* 133:383-393.
- Gardon JC, Matas C, Coy P, Gadea J (2001). Fecundación interespecífica de ovocitos porcinos con espermatozoides bovinos como método de evaluación espermática. *Rev Iberoam Fértil* 18:56-57.
- Gould-Somero M, Jaffe LA, Holland LZ (1979). Electrically mediated fast polyspermy block in eggs of the marine worm, *Urechis caupo*. *J Cell Biol* 82:426-440.
- Graham JK, Kunze E, Hammerstedt RH (1990). Analysis of sperm cell viability, acrosomal integrity, and mitochondrial function using flow cytometry. *Biol Reprod* 43:55-64.
- Green DP (1987). Mammalian sperm cannot penetrate the zona pellucida solely by force. *Exp Cell Res* 169:31-38.
- Green DP (1993). Mammalian fertilization as a biological machine: a working model for adhesion and fusion of sperm and oocyte. *Hum Reprod* 8:91-96.
- Green DP (1997). Three-dimensional structure of the zona pellucida. *Reviews of Reproduction* 2:147-156.
- Greve LC, Prody GA, Hedrick JL (1985). N-Acetyl- β -D-glucosaminidase activity in the cortical granules of *Xenopus laevis* eggs. *Gamete Res* 12:305-312.
- Griveau JF, Renaud P, Le Lannou D (1994). An in vitro promoting role for hydrogen peroxide in human sperm capacitation. *Int J Androl* 17:300-307.
- Griveau JF, Renaud P, Le Lannou D (1995). Superoxide anion production by human spermatozoa as part of the ionophore-induced acrosome reaction process. *Int J Androl* 18:67-74.
- Gutierrez-Lopez MD, Ovalle S, Yanez-Mo M, Sanchez-Sanchez N, Rubinstein E, Olmo N, Lizarbe MA, Sanchez-Madrid F, Cabanas C (2003). A functionally relevant conformational epitope on the CD9 tetraspanin depends on the association with activated beta1 integrin. *J Biol Chem* 278:208-218.
- Guzick DS, Overstreet JW, Factor-Litvak P, Brazil CK, Nakajima ST, Coutifaris C et al. (2001). Sperm morphology, motility y concentration in fertile y infertile men. *N Engl J Med* 345:1388-1393.
- Hafez ESE (2000). Fecundación y segmentación. En Hafez ESE (ed.), reproducción e inseminación artificial en animales, 7^o ed. México: Interamericana.MC Graw-Hill; 8:113-127.
- Hammerstedt RH, Graham JK, Nolan J (1990). Cryopreservation of mammalian sperm: what we ask them to survive. *J Androl* 11:73-88.
- Hanada A, Chang MC (1976). Penetration of hamster and rabbit zona-free eggs by rat and mouse spermatozoa with special reference to sperm capacitation. *J Reprod Fertil* 46:239-241.
- Hanada A, Chang MC (1978). Penetration of the zona-free or intact eggs by foreign spermatozoa and the fertilization of deer mouse eggs in vitro. *J Exp Zool* 203:277-285.
- Hao Y, Mathialagan N, Walters E, Mao J, Lai L, Becker D, Li W, Critser J, Prather RS (2006). Osteopontin reduces polyspermy during in vitro fertilization of porcine oocytes. *Biol Reprod* 75:726-733.
- Hardy DM, Garbers DL (1994). Species-specific binding of sperm proteins to the extracellular matrix (zona pellucida) of the egg. *J Biol Chem* 269:19000-19004.
- Harper CV, Publicover SJ (2005). Reassessing the role of progesterone in fertilization--compartmentalized calcium signalling in human spermatozoa?. *Hum Reprod* 20:2675-2680.

- Harris JD, Hibler DW, Fontenot GK, Hsu KT, Yurewicz EC, Sacco AG (1994). Cloning and characterization of zona pellucida genes and cDNAs from a variety of mammalian species: the ZPA, ZPB and ZPC gene families. *DNA Seq* 4:361-93.
- Hartmann JF (1983). Mammalian fertilization: gamete surface interactions in vitro. In: Hartmann, JF (ed.), *Mechanism and Control of Animal Fertilization*. Academic Press, New York, 325–364.
- He ZY, Brakebusch C, Fassler R, Kreidberg JA, Primakoff P, Myles DG (2003). None of the integrins known to be present on the mouse egg or to be ADAM receptors are essential for sperm-egg binding and fusion. *Dev Biol* 254:226-237.
- Hedrick JL, Wardrip NJ (1987). On the macromolecular composition of the zona pellucida from porcine oocytes. *Dev Biol* 121:478-488.
- Henkel R, Muller C, Miska W, Gips H, Schill WB (1993). Determination of the acrosome reaction in human spermatozoa is predictive of fertilization in vitro. *Hum Reprod* 8:2128-2132.
- Henley N, Baron C, Roberts KD (1994). Flow cytometric evaluation of the acrosome reaction of human spermatozoa: a new method using a photoactivated supravital stain. *Int J Androl* 17:78-84.
- Herrick SB, Schweissinger DL, Kim SW, Bayan KR, Mann S, Cardullo RA (2005). The acrosomal vesicle of mouse sperm is a calcium store. *Cell Physiol* 202:663-671.
- Herrick SB, Schweissinger DL, Kim SW, Bayan KR, Mann S, Cardullo RA (2005). The acrosomal vesicle of mouse sperm is a calcium store. *J Cell Physiol* 202:663-671.
- Herrler A, Beier HM (2000). Early embryonic coats: morphology, function, practical applications. An overview. *Cells Tissues Organs*. 166:233-246.
- Hewitson L, Haavisto A, Simerly C, Jones J, Schatten G (1997). Microtubule organization and chromatin configurations in hamster oocytes during fertilization and parthenogenetic activation, and after insemination with human sperm. *Biol Reprod* 57:967-975.
- Hoodbhoy T, Talbot P (1994). Mammalian cortical granules: contents, fate, and function. *Mol Reprod Dev* 39:439-448.
- Hoodbhoy T, Joshi S, Boja ES, Williams SA, Stanley P, Dean J (2005). Human sperm do not bind to rat zonae pellucidae despite the presence of four homologous glycoproteins. *J Biol Chem* 280:12721-12731.
- Hoshi K, Sugano T, Endo C, Yoshimatsu N, Yanagida K, Sato A (1993). Induction of the acrosome reaction in human spermatozoa by human zona pellucida and effect of cervical mucus on zona-induced acrosome reaction. *Fertil Steril* 60:149-153.
- Hoshi K, Katayose H, Yanagida K, Kimura Y, Sato A (1996). The relationship between acridine orange fluorescence of sperm nuclei and the fertilizing ability of human sperm. *Fertil Steril* 66:634-639.
- Hoshiba H, Sinowatz F (1998). Immunohistochemical localization of the spermadhesin AWN-1 in the equine male genital tract. *Anat Histol Embryol* 27:351-353.
- Huang TTF, Yanagimachi R (1985). Inner acrosomal membrane of mammalian spermatozoa: its properties and possible functions in fertilization. *Am J Anat* 174:249-268.
- Hunter RHF (1990). Fertilization of pig eggs in vitro and in vivo. *J Reprod Fertil (suppl)* 40:211-226.
- Hunter RH (1991). Oviduct function in pigs, with particular reference to the pathological condition of polyspermy. *Mol Reprod Dev* 29:385-391.
- Hunter RH, Rodriguez-Martinez H (2004). Capacitation of mammalian spermatozoa in vivo, with a specific focus on events in the Fallopian tubes. *Mol Reprod Dev* 67:243-250.

- Hunter RH (2005). The Fallopian tubes in domestic mammals: how vital is their physiological activity? *Reprod Nutr Dev* 45:281-90.
- Hyttel P, Viuff D, Laurincik J, Schmidt M, Thomsen PD, Avery B, Callesen H, Rath D, Niemann H, Rosenkranz C, Schellander K, Ochs RL, Greve T (2000). Risks of in-vitro production of cattle and swine embryos: aberrations in chromosome numbers, ribosomal RNA gene activation and perinatal physiology. *Hum Reprod (Suppl)* 5:87-97.
- Inoue N, Ikawa M, Isotani A, Okabe M (2005). The immunoglobulin superfamily protein Izumo is required for sperm to fuse with eggs. *Nature* 434:234-238.
- Ivanova M, Mollova M (1993). Zona-penetration in vitro test for evaluating boar sperm fertility. *Theriogenology* 40:397-410.
- Ivic A, Onyeaka H, Girling A, Brewis IA, Ola B, Hammadih N, Papaioannou S, Barratt CL (2002). Critical evaluation of methylcellulose as an alternative medium in sperm migration tests. *Hum Reprod.* 17:143-149.
- Iwamoto K, Ikeda K, Yonezawa N, Noguchi S, Kudo K, Hamano S, Kuwayama M, Nakano M (1999). Disulfide formation in bovine zona pellucida glycoproteins during fertilization: evidence for the involvement of cystine cross-linkages in hardening of the zona pellucida. *J Reprod Fertil* 117:395-402.
- Jaffe LA, Cross NL (1984). Electrical properties of vertebrate oocyte membranes. *Biol Reprod* 30:50-54.
- Jahn R, Grubmuller H (2002). Membrane fusion. *Curr Opin Cell Biol.* 2002 Aug;14(4):488-95.
- Jang S, Yi LS (2005). Identification of a 71 kDa protein as a putative non-genomic membrane progesterone receptor in boar spermatozoa. *J Endocrinol* 184:417-425.
- Jimenez-Movilla M, Aviles M, Gomez-Torres MJ, Fernandez-Colom PJ, Castells MT, de Juan J, Romeu A, Ballesta J (2004). Carbohydrate analysis of the zona pellucida and cortical granules of human oocytes by means of ultrastructural cytochemistry. *Hum Reprod* 19:1842-1855.
- Jury JA, Frayne J, Hall L (1997). The human fertilin alpha gene is non-functional: implications for its proposed role in fertilization. *Biochem J* 321:577-581.
- Kaji K, Oda S, Miyazaki S, Kudo A (2002). 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. *Dev Biol* 247:327-334.
- Kaji K, Kudo A (2004). The mechanism of sperm-oocyte fusion in mammals. *Reproduction* 127:423-429.
- Kim K, Mitsumizo N, Fujita K, Utsumi K (1996). The effects of follicular fluid on in vitro maturation, oocyte fertilization and the development of bovine embryos. *Theriogenology* 45:787-799.
- Kim NH, Jun SH, Do JT, Uhm SJ, Lee HT, Chung KS (1999). Intracytoplasmic injection of porcine, bovine, mouse, or human spermatozoon into porcine oocytes. *Mol Reprod Dev* 53:84-91.
- Kim KS, Cha MC, Gerton GL (2001) Mouse sperm protein sp56 is a component of the acrosomal matrix. *Biol Reprod* 64:36-43.
- Kim E, Baba D, Kimura M, Yamashita M, Kashiwabara S, Baba T (2005). Identification of a hyaluronidase, Hyal5, involved in penetration of mouse sperm through cumulus mass. *PNAS* 102:18028-18033.
- Kirkman-Brown JC, Lefievre L, Bray C, Stewart PM, Barratt CL, Publicover SJ (2002). Inhibitors of receptor tyrosine kinases do not suppress progesterone-induced [Ca²⁺]_i signalling in human spermatozoa. *Mol Hum Reprod* 8:326-332.

- Kolbe T, Holtz W (2005). Differences in proteinase digestibility of the zona pellucida of in vivo and in vitro derived porcine oocytes and embryos. *Theriogenology* 63:1695-1705.
- Kouba AJ, Abeydeera LR, Alvarez IM, Day BN, Buhi WC (2000). Effects of the porcine oviduct-specific glycoprotein on fertilization, polyspermy, and embryonic Biol Reprod 63:242-50.
- Kouba AJ, Atkinson MW, Gandolf AR, Roth TL (2001). Species-specific sperm-egg interaction affects the utility of a heterologous bovine in vitro fertilization system for evaluating antelope sperm. *Biol Reprod* 65:1246-1251.
- Koukoulis GN, Vantman D, Dennison L, Banks SM, Sherins RJ (1989). Low acrosin activity in a subgroup of men with idiopathic infertility does not correlate with sperm density, percent motility, curvilinear velocity, or linearity. *Fertil Steril* 52:120-127.
- Lambert H, Steinleitner A, Eisermann J, Serpa N, Cantor B (1992). Enhanced gamete interaction in the sperm penetration assay after coincubation with pentoxifylline and human follicular fluid. *Fertil Steril* 58:1205-1208.
- Lanzendorf SE, Holmgren WJ, Johnson DE, Scobey MJ, Jeyendran RS (1992). Hemizona assay for measuring zona binding in the lowland gorilla. *Mol Reprod Dev* 31:264-267.
- Lapointe S, Sirard MA (1996). Importance of calcium for the binding of oviductal fluid proteins to the membranes of bovine spermatozoa. *Mol Reprod Dev* 44:234-240.
- Larson KL, DeJonge CJ, Barnes AM, Jost LK, Evenson DP (2000). Sperm chromatin structure assay parameters as predictors of failed pregnancy following assisted reproductive techniques. *Hum Reprod* 15:1717-1722.
- Lee MA, Trucco GS, Bechtol KB, Wummer N, Kopf GS, Blasco L, Storey BT (1987). Capacitation and acrosome reactions in human spermatozoa monitored by a chlortetracycline fluorescence assay. *Fertil Steril* 48:649-658.
- Lee MA, Storey BT (1989). Endpoint of first stage of zona pellucida-induced acrosome reaction in mouse spermatozoa characterized by acrosomal H⁺ and Ca²⁺ permeability: population and single cell kinetics. *Gamete Res* 24:303-326.
- Lee JD, Kamiguchi Y, Yanagimachi R (1996). Analysis of chromosome constitution of human spermatozoa with normal and aberrant head morphologies after injection into mouse oocytes. *Hum Reprod* 11:1942-1946.
- Lefievre L, Conner SJ, Salpekar A, Olufowobi O, Ashton P, Pavlovic B, Lenton W, Afnan M, Brewis IA, Monk M, Hughes DC, Barratt CLR (2004). Four zona pellucida glycoproteins are expressed in the human. *Hum. Reprod* 19:1580-1586.
- Lewis SE, Sterling ES, Young IS, Thompson W (1997). Comparison of individual antioxidants of sperm and seminal plasma in fertile and infertile men. *Fertil Steril* 67:142-147.
- Lewis WH, Wright ES (1935). On the early development of the mouse egg. *Carnegie Inst. Contrig. Embryol.* 25, 113-143.
- Leyton L, Saling PM (1989). Evidence that aggregation of mouse sperm receptors by ZP3 triggers the acrosome reaction. *J Cell Biol* 108:2163-2168.
- Li YH, Ma W, Li M, Hou Y, Jiao LH, Wang WH (2003). Reduced polyspermic penetration in porcine oocytes inseminated in a new in vitro fertilization (IVF) system: straw IVF. *Biol Reprod* 69:1580-1585.
- Lin Y, Mahan K, Lathrop WF, Myles DG, Primakoff P (1994). A hyaluronidase activity of the sperm plasma membrane protein PH-20 enables sperm to penetrate the cumulus cell layer surrounding the egg. *J Cell Biol* 125:1157-1163.

- Lindsay LL, Hedrick JL (2004). Proteolysis of *Xenopus laevis* egg envelope ZPA triggers envelope hardening. *Biochem Biophys Res Commun* 324:648-654.
- Litscher ES, Wassarman PM (2007). Egg extracellular coat proteins: from fish to mammals. *Histol Histopathol* 22:337-347.
- Liu DY, Lopata A, Johnston WI, Baker HW (1988). A human sperm-zona pellucida binding test using oocytes that failed to fertilize in vitro. *Fertil Steril* 50:782-788.
- Liu DY, Lopata A, Pantke P, Baker HW (1991). Horse and marmoset monkey sperm bind to the zona pellucida of salt-stored human oocytes. *Fertil Steril* 56:764-767.
- Liu DY, Baker HW (1992). Tests of human sperm function and fertilization in vitro. *Fertil Steril* 58:465-483.
- Liu DY, Baker HW (1996a). A simple method for assessment of the human acrosome reaction of spermatozoa bound to the zona pellucida: lack of relationship with ionophore A23187-induced acrosome reaction. *Hum Reprod* 11:551-557.
- Liu DY, Baker HW (1996b). Relationship between the zona pellucida (ZP) and ionophore A23187-induced acrosome reaction and the ability of sperm to penetrate the ZP in men with normal sperm-ZP binding. *Fertil Steril* 66:312-315.
- Liu DY, Baker HW (1998). Calcium ionophore-induced acrosome reaction correlates with fertilization rates in vitro in patients with teratozoospermic semen. *Hum Reprod* 13:905-910.
- Liu DY, Baker HW (2003). Disordered zona pellucida-induced acrosome reaction and failure of in vitro fertilization in patients with unexplained infertility. *Fertil Steril* 79:74-80.
- Liu DY, Garrett C, Baker HW (2004). Clinical application of sperm-oocyte interaction tests in in vitro fertilization-embryo transfer and intracytoplasmic sperm injection programs. *Fertil Steril* 82:1251-1263.
- Loffler S, Lottspeich F, Lanza F, Azorsa DO, ter Meulen V, Schneider-Schaulies J (1997). CD9, a tetraspan transmembrane protein, renders cells susceptible to canine distemper virus. *J Virol* 71:42-49.
- Lopez LC, Bayna EM, Litoff D, Shaper NL, Shaper JH, Shur BD (1985). Receptor function of mouse sperm surface galactosyltransferase during fertilization. *J Cell Biol* 101:1501-1510.
- Losel R, Dorn-Beineke A, Falkenstein E, Wehling M, Feuring M (2004). Porcine spermatozoa contain more than one membrane progesterone receptor. *Int J Biochem Cell Biol* 36:1532-1541.
- Macedo MC Jr, Deschamps JC, Lucia T Jr, Bordignon J, Serret CG, Rambo G, Pivato I, Schmitt E (2006). In vitro penetration of fresh and vitrified swine oocytes by homologous spermatozoa using different incubation systems. *Anim Reprod Sci* 92:334-348.
- Macomber D, Sanders MB (1929). The spermatozoa count: its value in the diagnosis, prognosis, and treatment of sterility. *N Engl J Med* 200:981
- Maluchnik D, Borsuk E (1994). Sperm entry into fertilized mouse eggs. *Zygote* 2:129-131.
- Martic M, Moses EK, Adams TE, Liu DY, Gook DA, Garrett C, Dunlop ME, Baker GH (2004). Recombinant human zona pellucida proteins ZP1, ZP2 and ZP3 co-expressed in a human cell line. *Asian J Androl* 6:3-13.
- Martinez E, Vazquez JM, Matas C, Roca J, Coy P, Gadea J (1993). Evaluation of boar spermatozoa penetrating capacity using pig oocytes at the germinal vesicle stage. *Theriogenology* 40:547-557.

- Matas C, Martinez E, Vazquez JM, Roca J, Gadea J (1996). In vitro penetration assay of boar sperm fertility: Effect of various factors on the penetrability of immature pig oocytes. *Theriogenology* 46:503-513.
- McCauley TC, Buhi WC, Wu GM, Mao J, Caamaño JN, Didion BA, Day BN (2003). Oviduct-Specific Glycoprotein Modulates Sperm-Zona Binding and Improves Efficiency of Porcine Fertilization In Vitro. *Biol Reprod* 69:828-834.
- McHugh JA, Rutledge JJ (1998). Heterologous fertilization to characterize spermatozoa of the genus *Bos*. *Theriogenology* 50:185-193.
- Meizel S, Turner KO (1991). Progesterone acts at the plasma membrane of human sperm. *Mol Cell Endocrinol* 77:1-5.
- Mermillod P, Oussaid B, Cognie Y (1999). Aspects of follicular and oocyte maturation that affect the developmental potential of embryos. *J Reprod Fertil Suppl* 54:449-60.
- Meyers SA, Rosenberger AE (1999). A plasma membrane-associated hyaluronidase is localized to the posterior acrosomal region of stallion sperm and is associated with spermatozoal function. *Biol Reprod* 61:444-451.
- Michelmann HW, Bonhoff A, Mettler L (1986). Chromosome analysis in polyploid human embryos. *Hum Reprod* 1:243-246.
- Miller DJ, Macek MB, Shur BD (1992). Complementarity between sperm surface beta-1,4-galactosyltransferase and egg-coat ZP3 mediates sperm-egg binding. *Nature* 357:589-593.
- Miller DJ, Gong XH, Decher G, Shur BD (1993). Egg cortical granule N-acetylglucosaminidase is required for the mouse zona block to polyspermy. *J Cell Biol* 123:1431-1440.
- Miller DJ, Georges-Labouesse E, Primakoff P, Myles DG (2000). Normal fertilization occurs with eggs lacking the integrin alpha6beta1 is CD9-dependent. *J Cell Biol* 149:1289-1296.
- Miller DJ, Shi X, Burkin H (2002). Molecular basis of mammalian gamete binding. *Recent Prog Horm Res* 57:37-73.
- Miyado K, Yamada G, Yamada S, Hasuwa H, Nakamura Y, Ryu F, Suzuki K, Kosai K, Inoue K, Ogura A, Okabe M, Mekada E (2000). Requirement of CD9 on the egg plasma membrane for fertilization. *Science* 287:321-324.
- Miyazaki S, Shirakawa H, Nakada K, Honda Y (1993). Essential role of the inositol 1,4,5-trisphosphate receptor/Ca²⁺ release channel in Ca²⁺ waves and Ca²⁺ oscillations at fertilization of mammalian eggs. *Dev Biol* 158:62-78.
- Moller CC, Wassarman PM (1989). Characterization of a proteinase that cleaves zona pellucida glycoprotein ZP2 following activation of mouse eggs. *Dev Biol* 132:103-112.
- Moller CC, Bleil JD, Kinloch RA, Wassarman PM (1990). Structural and functional relationships between mouse and hamster zona pellucida glycoproteins. *Dev Biol* 137:276-286.
- Morales P, Cross NL, Overstreet JW, Hanson FW (1989). Acrosome intact and acrosome-reacted human sperm can initiate binding to the zona pellucida. *Dev Biol* 133:385-392.
- Morales P, Vigil P, Franken DR, Kaskar K, Coetzee K, Kruger TF (1994). Sperm-oocyte interaction: studies on the kinetics of zona pellucida binding and acrosome reaction of human spermatozoa. *Andrologia* 26:131-137.
- Mori E, Yoshitani N, Mori T, Takasaki S (2000). Calcium ion-independent recognition of sialyl and nonsialyl N-acetyllactosamine and Le(x) structures by boar sperm. *Arch Biochem Biophys* 374:86-92.

- Mortillo S, Wassarman PM (1991). Differential binding of gold-labeled zona pellucida glycoproteins mZP2 and mZP3 to mouse sperm membrane components. *Development* 113:141-149.
- Moseley FL, Jha KN, Bjorndahl L, Brewis IA, Publicover SJ, Barratt CL, Lefievre L. (2005). Protein tyrosine phosphorylation, hyperactivation and progesterone-induced acrosome reaction are enhanced in IVF media: an effect that is not associated with an increase in protein kinase A activation. *Mol Hum Reprod* 11:523-529.
- Muller CH (2000). Rationale interpretation, validation and uses of sperm function tests. *Journal of Andrology* 21:10-30.
- Myles DG, Hyatt H, Primakoff P (1987). Binding of both acrosome-intact and acrosome-reacted guinea pig sperm to the zona pellucida during in vitro fertilization. *Dev Biol* 121:559-567.
- Myles DG, Kimmel LH, Blobel CP, White JM, Primakoff P (1994). Identification of a binding site in the disintegrin domain of fertilin required for sperm-egg fusion. *PNAS USA* 91:4195-4198.
- Nagai T, Funahashi H, Yoshioka K, Kikuchi K (2006). Up date of in vitro production of porcine embryos. *Front Biosci* 11:2565-2573.
- Naish SJ, Perreault SD, Zirkin BR (1987). DNA synthesis following microinjection of heterologous sperm and somatic cell nuclei into hamster oocytes. *Gamete Res* 18:109-120.
- Nakamura S, Terada Y, Horiuchi T, Emuta C, Murakami T, Yaegashi N, Okamura K (2001). Human sperm aster formation and pronuclear decondensation in bovine eggs following intracytoplasmic sperm injection using a Piezo-driven pipette: a novel assay for human sperm centrosomal function. *Biol Reprod* 65:1359-1363.
- Nakano M, Yonezawa N (2001). Localization of sperm ligand carbohydrate chains in pig zona pellucida glycoproteins. *Cells Tissues Organs* 168:65-75. .
- Naz RK, Ahmad K, Kumar R (1991). Role of membrane phosphotyrosine proteins in human spermatozoal function. *J Cell Sci* 99:157-165.
- Ni Y, Li K, Xu W, Song L, Yao K, Zhang X, Huang H, Zhang Y, Shi QX (2006). Acrosome reaction induced by recombinant human zona pellucida 3 peptides rhuZP3a22~176 and rhuZP3b177~348 and their mechanism. *J Androl*. Dec 27.
- Nichols J, Gardner RL (1989). Effect of damage to the zona pellucida on development of preimplantation embryos in the mouse. *Hum Reprod* 4:180-187.
- Niemann H, Rath D, Wrenzycki C (2003). Advances in biotechnology: new tools in future pig production for agriculture and biomedicine. *Reprod Domest Anim* 38:82-89.
- Nishimura H, Cho C, Branciforte DR, Myles DG, Primakoff P (2001). Analysis of loss of adhesive function in sperm lacking cyritestin or fertilin beta. *Dev Biol* 233:204-213.
- Nixon B, Lu Q, Wassler MJ, Foote CI, Ensslin MA, Shur BD (2001). Galactosyltransferase function during mammalian fertilization. *Cells Tissues Organs* 168:46-57.
- Noguchi S, Hatanaka Y, Tobita T, Nakano M (1992). Structural analysis of the N-linked carbohydrate chains of the 55-kDa glycoprotein family (PZP3) from porcine zona pellucida. *Eur J Biochem* 204:1089-1100.
- Noguchi S, Nakano M (1992). Structure of the acicic N-linked carbohydrate chains of the 55-kDa glycoprotein family (PZP3) from porcine zona pellucida. *Eur J Biochem* 209:883-894.
- Noguchi S, Yonezawa N, Katsumata T, Hashizume K, Kuwayama M, Hamano S, Watanabe S, Nakano M (1994). Characterization of the zona pellucida glycoproteins from bovine ovarian and fertilized eggs. *Biochim Biophys Acta* 1201:7-14.

- Nolan JP, Hammerstedt RH (1997). Regulation of membrane stability and the acrosome reaction in mammalian sperm. *FASEB J* 11:670-682.
- Oehninger S, Mahony MC, Swanson JR, Hodgen GD (1993). The specificity of human spermatozoa/zona pellucida interaction under hemizona assay conditions. *Mol Reprod Dev* 35:57-61.
- Oehninger S, Blackmore P, Morshedi M, Sueldo C, Acosta AA, Alexander NJ (1994). Defective calcium influx and acrosome reaction (spontaneous and progesterone-induced) in spermatozoa of infertile men with severe teratozoospermia. *Fertil Steril* 61:349-354.
- Oehninger S, Franken DR, Sayed E, Barroso G, Kolm P (2000). Sperm function assays and their predictive value for fertilization outcome in IVF therapy: a meta-analysis. *Hum Reprod Update* 6:160-168.
- Ogawa S, Araki S, Araki Y, Ohno M, Sato I (2000). Chromosome analysis of human spermatozoa from an oligoasthenozoospermic carrier for a 13;14 Robertsonian translocation by their injection into mouse oocytes. *Hum Reprod* 15:1136-1139.
- Okitsu O, Yamano S, Aono T (2001). Activation of bovine oocytes matured in vitro by injection of bovine and human spermatozoa or their cytosolic fractions. *Zygote* 9:89-95.
- Olds-Clarke P (1989). Sperm from t w32/+ mice: capacitation is normal, tub pyperactivation is premature and nonhyperactivated sperm are slow. *Dev Biol* 131:475-482.
- O'Rand MG, Matthews JE, Welch JE, Fisher SJ (1985). Identification of zona binding proteins of rabbit, pig, human, and mouse spermatozoa on nitrocellulose blots. *J Exp Zool* 235:423-428.
- Osman RA, Andria ML, Jones AD, Meizel S (1989). Steroid induced exocytosis: the human sperm acrosome reaction. *Biochem Biophys Res Commun* 160:828-833.
- Ostling O, Johanson KJ (1984). Microelectrophoretic study of radiation-induced DNA damages in individual mammalian cells. *Biochem Biophys Res Commun* 123:291-298.
- Pampiglione JS, Tan SL, Campbell S (1993). The use of the stimulated acrosome reaction test as a test of fertilizing ability in human spermatozoa. *Fertil Steril* 59:1280-1284.
- Parinaud J, Labal B, Vieitez G (1992). High progesterone concentrations induce acrosome reaction with a low cytotoxic effect. *Fertil Steril* 58:599-602.
- Parinaud J, Vieitez G, Moutaffian H, Richoilley G, Labal B (1995). Relevance of acrosome function in the evaluation of semen in vitro fertilizing ability. *Fertil Steril* 63:598-603.
- Parrish JJ, Susko-Parrish J, Winer MA, First NL (1988). Capacitation of bovine sperm by heparin. *Biol Reprod* 38:1171-1180.
- Pavlok A (1980). Interaction of the plasma membrane of mouse, rat and hamster oocytes with human spermatozoa in vitro. *Folia Biol (Praha)*. 26:188-193.
- Pelletier C, Keefe DL, Trimarchi JR (2004). Noninvasive polarized light microscopy quantitatively distinguishes the multilaminar structure of the zona pellucida of living human eggs and embryos. *Fertil Steril* 81 1:850-856.
- Perry RL, Barratt CL, Warren MA, Cooke ID (1996). Comparative study of the effect of human cervical mucus and a cervical mucus substitute, Healonid, on capacitation and the acrosome reaction of human spermatozoa in vitro. *Hum Reprod* 11:1055-1062.
- Phillips DM, Shalgi RM (1980). Surface architecture of the mouse and hamster zona pellucida and oocyte. *J Ultrastruct Res* 72:1-12.
- Pilikian S, Guerin JF, Adeleine P, Ecochard R, Czyba JC (1992). Spontaneous and ionophore induced acrosome reaction in asthenozoospermic infertile semen. *Hum Reprod* 7:991-993.

- Prather RS, Day BN (1998). Practical considerations for the in vitro production of pig embryos. *Theriogenology*. 49:23-32.
- Primakoff P, Hyatt H (1986). An antisperm monoclonal antibody inhibits sperm fusion with zona-free hamster eggs but not homologous eggs. *Fertil Steril* 46:489-493.
- Primakoff P, Myles DG (2002). Penetration, adhesion, and fusion in mammalian sperm-egg interaction. *Science* 296:2183-215.
- Purvis K, Rui H, Scholberg A, Hesla S, Clausen OP (1990). Application of flow cytometry to studies on the human acrosome. *J Androl* 11:361-366.
- Putney JW (1990). Capacitative calcium entry revisited. *Cell Calcium* 11:611-624.
- Quill TA, Sugden SA, Rossi KL, Doolittle LK, Hammer RE, Garbers DL (2003). Hyperactivated sperm motility driven by CatSper2 is required for fertilization. *PNAS* 100:14869-14874.
- Quinn P (1979). Failure of human spermatozoa to penetrate zona free mouse and rat ova in vitro. *J Exp Zool* 210:497-505.
- Rankin T, Talbot P, Lee E, Dean J (1999). Abnormal zonae pellucidae in mice lacking ZP1 result in early embryonic loss. *Development* 126:3847-3855.
- Rankin T, Dean J (2000). The zona pellucida: using molecular genetics to study the mammalian egg coat. *Rev Reprod* 5:114-121.
- Rankin TL, Coleman JS, Epifano O, Hoodbhoy T, Turner SG, Castle PE, Lee E, Gore-Langton R, Dean J (2003). Fertility and taxon-specific sperm binding persist after replacement of mouse sperm receptors with human homologs. *Dev Cell* 5:33-43.
- Rath D, Long CR, Dobrinsky JR, Welch GR, Schreier LL, Johnson LA (1999). In vitro production of sexed embryos for gender preselection: high-speed sorting of X-chromosome-bearing sperm to produce pigs after embryo transfer. *J Anim Sci* 77:3346-3352.
- Rath D, Topfer-Petersen E, Michelmann HW, Schwartz P, Ebeling S (2005). Zona pellucida characteristics and sperm-binding patterns of in vivo and in vitro produced porcine oocytes inseminated with differently prepared spermatozoa. *Theriogenology*. 63:352-362.
- Rath D, Topfer-Petersen E, Michelmann HW, Schwartz P, von Witzendorff D, Ebeling S, Ekhlasi-Hundrieser M, Piehler E, Petrunkina A, Romar R (2006). Structural, biochemical and functional aspects of sperm-oocyte interactions in pigs. *Soc Reprod Fertil Suppl* 62:317-330.
- Redkar AA, Olds-Clarke PJ (1999). An improved mouse sperm-oocyte plasmalemma binding assay: studies on characteristics of sperm binding in medium with or without glucose. *J Androl* 20:500-508.
- Relucanti M, Heyn R, Correr S, Familiari G (2005). Cumulus oophorus extracellular matrix in the human oocyte: a role for adhesive proteins. *Ital J Anat Embryol* 110(2 Suppl 1):219-224.
- Rockwell PL, Storey BT (2000). Kinetics of onset of mouse sperm acrosome reaction induced by solubilized zona pellucida: fluorimetric determination of loss of pH gradient between acrosomal lumen and medium monitored by dapoxyl (2-aminoethyl) sulfonamide and of intracellular Ca(2+) changes monitored by fluo-3. *Mol Reprod Dev* 55:335-349.
- Rodeheffer C, Shur BD (2004). Characterization of a novel ZP3-independent sperm-binding ligand that facilitates sperm adhesion to the egg coat. *Development* 131:503-512.
- Rodriguez-Martinez H, Tienthai P, Suzuki K, Funahashi H, Ekwall H, Johannisson A (2001). Involvement of oviduct in sperm capacitation and oocyte development in pigs. *Reprod Suppl* 58:129-145.

- Roldan ER, Murase T, Shi QX (1994). Exocytosis in spermatozoa in response to progesterone and zona pellucida. *Science* 266:1578-1581.
- Romar R, Coy P, Campos I, Gadea J, Matas C, Ruiz S (2001). Effect of co-culture of porcine sperm and oocytes with porcine oviductal epithelial cells on in vitro fertilization. *Anim Reprod Sci* 68:85-98.
- Romar R, Coy P, Gadea J, Rath D (2005). Effect of oviductal and cumulus cells on zona pellucida and cortical granules of porcine oocytes fertilized in vitro with epididymal spermatozoa. *Anim Reprod Sci* 85:287-300.
- Romar R, Carrasco LC, Aviles M, Coy P (2007). Enzymatic activity level of different glycosidases in porcine oviductal fluid at different stages of the estrous cycle. 33rd Annual Conference of the International Embryo Transfer Society (IETS), Kyoto (Japan). *Reproduction, Fertility and Development*.
- Roth TL, Weiss RB, Buff JL, Bush LM, Wildt DE, Bush M (1998). Heterologous in vitro fertilization and sperm capacitation in an endangered African antelope, the Scimitar-horned oryx (*Oryx dammah*). *Biol Reprod* 58:475-482.
- Roth TL, Bush LM, Wildt DE, Weiss RB (1999). Scimitar-horned oryx (*Oryx dammah*) spermatozoa are functionally competent in a heterologous bovine *in vitro* fertilization system after cryopreservation on dry ice, in a dry shipper, or over liquid nitrogen vapor. *Biol Reprod* 60:493-498.
- Rybouchkin A, Dozortsev D, de Sutter P, Qian C, Dhont M (1995). Intracytoplasmic injection of human spermatozoa into mouse oocytes: a useful model to investigate the oocyte-activating capacity and the karyotype of human spermatozoa. *Hum Reprod* 10:1130-1135.
- Salustri A, Yanagishita M, Underhill CB, Laurent TC, Hascall VC (1992). Localization and synthesis of hyaluronic acid in the cumulus cells and mural granulosa cells of the preovulatory follicle. *Dev Biol* 151:541-551.
- Saudek V, Atkinson RA, Pelton JT (1991). Three-dimensional structure of echistatin, the smallest active RGD protein. *Biochem J* 30:7369-7372.
- Schatten G, Simerly C, Schatten H (1991). Maternal inheritance of centrosomes in mammals? Studies on parthenogenesis and polyspermy in mice. *PNAS USA* 88:6785-6789.
- Schill WB (1974). Quantitative determination of acrosin activity in human spermatozoa. *Fertil Steril* 25:703-712.
- Schill WB (1991). Some disturbances of acrosomal development and function in human spermatozoa. *Hum Reprod* 6:969-978.
- Schmell ED, Gulyas BJ (1980). Mammalian sperm-egg recognition and binding in vitro. I. Specificity of sperm interactions with live and fixed eggs in homologous and heterologous inseminations of hamster, mouse, and guinea pig oocytes. *Biol Reprod* 23:1075-1085.
- Schuffner AA, Bastiaan HS, Duran HE, Lin ZY, Morshedi M, Franken DR, Oehninger S (2002). Zona pellucida-induced acrosome reaction in human sperm: dependency on activation of pertussis toxin-sensitive G(i) protein and extracellular calcium, and priming effect of progesterone and follicular fluid. *Mol Hum Reprod* 8:722-727.
- Sengoku K, Takuma N, Miyamoto T, Horikawa M, Ishikawa M (2004). Integrins are not involved in the process of human sperm-oolemmal fusion. *Hum Reprod* 19:639-644.
- Shalgi R, Raz T (1997). The role of carbohydrate residues in mammalian fertilization. *Histol Histopathol* 12:813-822.
- Sharara FI, Illions EH, Coddington CC 3rd, Scott RT (1995). Evaluation of the Tru-Trax cervical mucus penetration test in predicting fertilization and pregnancy rates in in-vitro fertilization. *Hum Reprod* 10:1481-1485.

- Shur BD, Rodeheffer C, Ensslin MA (2004). Mammalian fertilization. *Curr Biol* 14:691-692.
- Shur BD, Rodeheffer C, Ensslin MA, Lyng R, Raymond A (2006). Identification of novel gamete receptors that mediate sperm adhesion to the egg coat. *Mol Cell Endocrinol* 250:137-148.
- Sikka SC (2004). Role of oxidative stress and antioxidants in andrology and assisted reproductive technology. *J Androl* 25:5-18.
- Simerly C, Wu GJ, Zoran S, Ord T, Rawlins R, Jones J, Navara C, Gerrity M, Rinehart J, Binor Z (1995). The paternal inheritance of the centrosome, the cell's microtubule-organizing center, in humans, and the implications for infertility. *Nat Med* 1:47-52.
- Sinowatz F, Kolle S, Topfer-Petersen E (2001a). Biosynthesis and expression of zona pellucida glycoproteins in mammals. *Cells Tissues Organs* 168:24-35
- Sinowatz F, Plendl J, Kolle S (1998). Protein-carbohydrate interactions during fertilization. *Acta Anat (Basel)* 161:196-205.
- Sinowatz F, Topfer-Petersen E, Koller S, Palma G (2001). Functional morphology of the zona pellucida. *Anat Histol Embryol* 5:257-263.
- Sinowatz F, Wessa E, Neumuller C, Palma G (2003). On the species Specificity of sperm binding and sperm penetration of the zona pellucida. *Reprod Dom Anim* 38:141-146.
- Slavik T, Pavlok A, Fulka J (1990). Penetration of intact bovine ova with ram sperm in vitro. *Mol Reprod Dev* 25:345-347.
- Slavik T, Fulka J (1992). In vitro fertilization of intact sheep and cattle oocytes with goat spermatozoa. *Theriogenology* 38:721-6.
- Slavik T, Fulka J (1999). Oviduct secretion contributes to the establishment of species specific barrier preventing penetration of oocytes with foreign spermatozoa. *Folia Biol (Praha)* 45:53-58.
- Smith R, Vantman D, Ponce J, Escobar J, Lissi E (1996). Total antioxidant capacity of human seminal plasma. *Hum Reprod* 11:1655-1660.
- Soderquist L, Rodriguez-Martinez H, Janson L (1991). Post-thaw motility, ATP content and cytochrome C oxidase activity of A. I. bull spermatozoa in relation to fertility. *Zbl Vet Med A* 38:165-174.
- Spargo SC, Hope RM (2003). Evolution and nomenclature of the zona pellucida gene family. *Biol Reprod* 68:358-362.
- Spungin B, Margalit I, Breitbart H (1995). Sperm exocytosis reconstructed in a cell-free system: evidence for the involvement of phospholipase C and actin filaments in membrane fusion. *Cell Sci* 108:2525-2535.
- Sun QY (2003). Cellular and molecular mechanisms leading to cortical reaction and polyspermy block in mammalian eggs. *Microsc Res Tech* 61:342-348.
- Staros AL, Killian GJ (1998). In vitro association of six oviductal fluid proteins with the bovine zona pellucida. *Reprod Fertil* 112:131-137.
- Stauss CR, Votta TJ, Suarez SS (1995). Sperm motility hyperactivation facilitates penetration of the master zona pellucida. *Biol Reprod* 53:1280-1285.
- Stein KK, Primakoff P, Myles D (2004). Sperm-egg fusion: events at the plasma membrane. *J Cell Sci* 117:6269-6274.
- Strom Holst B, Larsson B, Linde-Forsberg C, Rodriguez-Martinez H (2000). Sperm binding capacity and ultrastructure of the zona pellucida of stored canine oocytes. *J Reprod Fertil* 119:77-83.

- Sun JG, Jurisicova A, Casper RF (1997). Detection of deoxyribonucleic acid fragmentation in human sperm: correlation with fertilization in vitro. *Biol Reprod* 56:602-607.
- Takahashi K, Wetzels AM, Goverde HJ, Bastaans BA, Janssen HJ, Rolland R (1992). The kinetics of the acrosome reaction of human spermatozoa and its correlation with in vitro fertilization. *Fertil Steril* 57:889-894.
- Talbot P, Chacon RS (1981). A triple-stain technique for evaluating normal acrosome reactions of human sperm. *J Exp Zool* 215:201-208.
- Talbot P, Chacon RS (1982). Ultrastructural observations on binding and membrane fusion between human sperm and zona pellucida-free hamster oocytes. *Fertil Steril* 37:240-248.
- Talbot P, Shur BD, Myles DG (2003). Cell adhesion and fertilization: steps in oocyte transport, sperm-zona pellucida interactions, and sperm-egg fusion. *Biol Reprod* 68:1-9.
- Terada Y, Simerly CR, Hewitson L, Schatten G (2000). Sperm aster formation and pronuclear decondensation during rabbit fertilization and development of a functional assay for human sperm. *Biol Reprod* 62:557-563.
- Terada Y, Nakamura S, Morita J, Tachibana M, Morito Y, Ito K, Murakami T, Yaegashi N, Okamura K (2004a). Use of Mammalian eggs for assessment of human sperm function: molecular and cellular analyses of fertilization by intracytoplasmic sperm injection. *Am J Reprod Immunol* 51:290-293.
- Terada Y, Nakamura S, Simerly C, Hewitson L, Murakami T, Yaegashi N, Okamura K, Schatten G (2004b). Centrosomal function assessment in human sperm using heterologous ICSI with rabbit eggs: a new male factor infertility assay. *Mol Reprod Dev* 67:360-365.
- Tesarik J (1985). Comparison of acrosome reaction-inducing activities of human cumulus oophorus, follicular fluid and ionophore A23187 in human sperm populations of proven fertilizing ability in vitro. *J Reprod Fertil* 74:383-388.
- Tesarik J (1989). Appropriate timing of the acrosome reaction is a major requirement for the fertilizing spermatozoon. *Hum Reprod* 4:957-961.
- Tesarik J, Mendoza C (1993). Sperm treatment with pentoxifylline improves the fertilizing ability in patients with acrosome reaction insufficiency. *Fertil Steril* 60:141-148.
- Tesarik J, Mendoza C (1995). Alleviation of acrosome reaction prematurity by sperm treatment with egg yolk. *Fertil Steril* 63:153-157.
- Thaler CD, Cardullo RA (1996). The initial molecular interaction between mouse sperm and the zona pellucida is a complex binding event. *J Biol Chem* 271:23289-23297.
- Thibier M (2006). Biosecurity and the various types of embryos transferred. *Reprod Domest Anim* 41:260-267.
- Toshimori K, Saxena DK, Tanii I, Yoshinaga K (1998). An MN9 antigenic molecule, equatorin, is required for successful sperm-oocyte fusion in mice. *Biol Reprod* 59:22-29.
- Tsaadon A, Eliyahu E, Shtraizent N, Shalgi R (2006). When a sperm meets an egg: block to polyspermy. *Mol Cell Endocrinol* 252:107-114.
- van Duin M, Polman JE, De Breet IT, van Ginneken K, Bunschoten H, Grootenhuis A, Brindle J, Aitken RJ (1994). Recombinant human zona pellucida protein ZP3 produced by chinese hamster ovary cells induces the human sperm acrosome reaction and promotes sperm-egg fusion. *Biol Reprod* 51:607-617.
- Van Soom A, Tanghe S, De Pauw I, Maes D, de Kruif A (2002). Function of the cumulus oophorus before and during mammalian fertilization. *Reprod Domest Anim* 37:144-151.

- Vasconcelos JL, Silcox RW, Rosa GJ, Pursley JR, Wiltbank MC (1999). Synchronization rate, size of the ovulatory follicle, and pregnancy rate after synchronization of ovulation beginning on different days of the estrous cycle in lactating dairy cows. *Theriogenology* 52:1067-1078.
- Vatzias G, Hagen DR (1999). Effects of porcine follicular fluid and oviduct-conditioned media on maturation and fertilization of porcine oocytes in vitro. *Biol Reprod* 60:42-48.
- Velasquez JG, Canovas S, Barajas P, Marcos J, Jimenez-Movilla M, Gallego RG, Ballesta J, Aviles M, Coy P (2006). Role of sialic acid in bovine sperm-zona pellucida binding. *Mol Reprod Dev* 74:617-628.
- Visconti PE, Kopf GS (1998). Regulation of Protein Phosphorylation during Sperm Capacitation. *Biol Reprod* 59:1-6.
- Visconti PE, Ning X, Fornes MW, Alvarez JG, Stein P, Connors SA, Kopf GS (1999). Cholesterol efflux-mediated signal transduction in mammalian sperm: cholesterol release signals an increase in protein tyrosine phosphorylation during mouse sperm capacitation. *Dev Biol* 214:429-443.
- Wakayama T, Uehara T, Hayashi Y, Yanagimachi R (1997). The response of mouse oocytes injected with sea urchin spermatozoa. *Zygote* 5:229-234.
- Wang W, Hosoe M, Li R, Shioya Y (1997). Development of the competence of bovine oocytes to release cortical granules and block polyspermy after meiotic maturation. *Dev Growth Differ* 39:607-615.
- Wang W, Abeydeera L, Prather R, Day B (1998) Morphologic comparison of ovulated and in vitro-matured porcine oocytes, with particular reference to polyspermy after in vitro fertilization. *Mol Reprod Dev* 49:308-316.
- Wang WH, Day BN, Wu GM (2003). How does polyspermy happen in mammalian oocytes?. *Microsc Res Tech* 61:335-341.
- Wassarman PM (1988). Zona pellucida glycoproteins. *Annu Rev Biochem* 57:415-442.
- Wassarman PM, Albertini D (1994). The mammalian ovum. En: Knobil E y Neill JD. *The Physiology of Reproduction*. Vol 1: Cap. 3.
- Wassarman PM (1999). Fertilization in animals. *Dev Genet* 25:83-86.
- Wassarman PM, Jovine L, Litscher ES (2001). A profile of fertilization in mammals. *Nat Cell Biol* 3:59-64.
- Wassarman PM, Litscher ES (2001). Towards the molecular basis of sperm and egg interaction during mammalian fertilization. *Cells Tissues Organs* 168:36-45.
- Wassarman PM, Jovine L, Litscher ES, Qi H, Williams Z (2004). Egg-sperm interactions at fertilization in mammals. *Eur J Obstet Gynecol Reprod Biol* 115 Suppl 1:S57-60.
- Wassarman PM, Jovine L, Qi H, Williams Z, Darie C, Litscher ES (2005). Recent aspects of mammalian fertilization research. *Mol Cell Endocrinol*. 234:95-103.
- Way AL, Schuler AM, Killian GJ (1997). Influence of bovine ampullary and isthmic oviductal fluid on sperm-egg binding and fertilization in vitro. *J Reprod Fertil* 109:95-101.
- Wegner CC, Killian GJ (1991). In vitro and in vivo association of an oviduct estrus-associated protein with bovine zona pellucida. *Mol Reprod Dev* 29:77-84.
- Wheeler MB, Rutledge JJ, Fischer-Brown A, VanEtten T, Malusky S, Beebe DO (2006). Application of sexed semen technology to in vitro embryo production in cattle. *Theriogenology* 65:219-227.

WHO Laboratory Manual for the Examination of Human Semen and Sperm-Cervical Mucus Interaction (1999). 4^a Edición Corporate Author World Health Organisation. En: Cambridge University Press.

Williams CHA (2002). Signalling mechanisms of mammalian oocyte activation. *Hum Reprod Update* 8:313-321.

Windt ML, de Beer PM, Franken DR, Kruger TF, Bouic PJ (1992). The influence of solubilized porcine zona pellucida protein on the binding capacity of human spermatozoa. *Hum Reprod* 7:1150-1153.

Wolf DP (1974). The cortical response in *Xenopus laevis* ova. *Dev Biol* 40:102-115.

Wolf DP, Hamada M (1977). Induction of zonal and egg plasma membrane blocks to sperm penetration in mouse eggs with cortical granule exudate. *Biol Reprod* 17:350-354.

Wolf DP, Armstrong PB (1978). Penetration of the zona-free mouse egg by capacitated epididymal sperm: cinemicrographic observations. *Gamete Res* 1:39-46.

Wong JL, Wessel GM (2006). Defending the zygote: search for the ancestral animal block to polyspermy. *Curr Top Dev Biol* 72:1-151.

Wortzman GB, Evans JP (2005). Membrane and cortical abnormalities in post-ovulatory aged eggs: analysis of fertilizability and establishment of the membrane block to polyspermy. *Mol Hum Reprod*. 11:1-9.

Xu X, Ding J, Seth PC, Harbison DS, Foxcroft GR (1995). In vitro fertilization of in vitro matured pig oocytes: effects of boar and ejaculate fraction. *Theriogenology* 43:358 (abstr).

Yanagida K, Yanagimachi R, Perreault SD, Klinfeld RG (1991). Thermostability of sperm nuclei assessed by microinjection into hamster oocytes. *Biol Reprod* 44:440-447.

Yanagimachi R (1969). In vitro capacitation of hamster spermatozoa by follicular fluid. *J Reprod Fertil* 18:275-286.

Yanagimachi R, Noda YD (1970). Physiological changes in the postnuclear cap region of mammalian spermatozoa: a necessary preliminary to the membrane fusion between sperm yegg cells. *J Ultrastruct Res* 31:486-493.

Yanagimachi R, Yanagimachi H, Rogers BJ (1976). The use of zona-free animal ova as a test-system for the assessment of the fertilizing capacity of human spermatozoa. *Biol Reprod* 15:471-476.

Yanagimachi R (1988). Sperm-egg fusion. *Curr Top Membr Transp* 32:3-43.

Yanagimachi R (1994). Mammalian fertilization. In: Knobil E, Neil JD (eds.), *The Physiology of Reproduction*, 2nd ed. New York: Raven Press; 189-317.

Yonezawa N, Mitsui S, Kudo K, Nakano M (1997). Identification of an N-glycosylated region of pig zona pellucida glycoprotein ZPB that is involved in sperm binding. *Eur J Biochem* 248:86-92.

Yonezawa N, Fukui N, Kuno M, Shinoda M, Goko S, Mitsui S, Nakano M (2001). Molecular cloning of bovine zona pellucida glycoproteins ZPA and ZPB and analysis for sperm-binding component of the zona. *Eur J Biochem* 268:3587-3594.

Yoshida M, Ishizaki Y, Kawagishi H, Bamba K, Kojima Y (1992). Effects of pig follicular fluid on maturation of pig oocytes in vitro and on their subsequent fertilizing and developmental capacity in vitro. *J Reprod Fertil* 95:481-488

Yoshimatsu N, Yanagimachi R, Lopata A (1988). Zonae pellucidae of salt-stored hamster and human eggs: their penetrability by homologous and heterologous spermatozoa. *Gamete Res* 21:115-126.

Yurewicz EC, Sacco AG, Gupta SK, Xu N, Gage DA (1998). Hetero-oligomerization-dependent binding of pig oocyte zona pellucida glycoproteins ZPB and ZPC to boar sperm membrane vesicles. *J Biol Chem* 273:7488-7494.

Zahalsky MP, Zoltan E, Medley N, Nagler HM (2003). Morphology and the sperm penetration assay. *Fertil Steril* 79:39-41.

Zaneveld LJ, Anderson RA, Mack SR, De Jonge CJ (1993). Mechanism and control of the human sperm acrosome reaction. *Hum Reprod* 8:2006-2008.

Zhao XM, Songa XX, Kawai Y, Niwa K (2002). Penetration in vitro of zona-free pig oocytes by homologous and heterologous spermatozoa. *Theriogenology* 58:995-1006.

Zhu X, Naz RK (1999). Comparison of ZP3 protein sequences among vertebrate species: to obtain a consensus sequence for immunocontraception. *Front Biosci* 4:212-215.

Zhu X, Evans JP (2002). Analysis of the roles of RGD-binding integrins, alpha(4)/alpha(9) integrins, alpha(6) integrins, and CD9 in the interaction of the fertilin beta (ADAM2) disintegrin domain with the mouse egg membrane. *Biol Reprod* 66:1193-1202.

Ziyyat A, Naud-Barriant N, Barraud-Lange V, Chevalier F, Kulski O, Lemkecher T, Bomsel M, Wolf JP (2005). Cyclic FEE peptide increases human gamete fusion and potentiates its RGD-induced inhibition. *Hum Reprod* 20:3452-3458.