

Female Germ Cells in Development & Tumors

Guest Editors

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Preface

Study an egg today to make an embryo tomorrow

When accepting to guest edit this Special Issue, our thoughts went, of course, to our peers who would take advantage of the contributions included, but also to younger researchers and students and to how they would benefit from the use of this Special Issue as an open window to move in depth into some of the most updated advancements in our knowledge of the female gamete.

The breathtaking sense of wonder that the female germ cell inspires is well summarised by the renowned phrase of William Harvey '*Ex ovo omnia*', remarked on in a short black and white film titled 'In the Beginning' (<http://archive.org/details/IntheBeg1937>), a motion picture made by the U.S. Department of Agriculture, Bureau of Dairy Industry, sometime between 1935-1937 that starts, again, with Harvey's '*All animals, even the viviparous ones and even man himself, take their origin from eggs*' and continues showing what we believe to be one of the firsts successful attempts to film, with an educational purpose, the gametes during fertilisation and the preimplantation embryos during their segmentation divisions.

When the light is switched back, the projection is punctually followed by moments of silence, when we realise that, although almost 80 years have passed since that film was made, our knowledge of mammalian gametes and reproduction has improved very little – though it is a precious little. It is to this "little" that we dedicate this Special Issue.

The sequence of papers starts with an interview of David Albertini and his extraordinary contribution to the knowledge of 'the most wondrous of cells - the oocyte' and follows with a road map of the life of an oocyte from its origin as a primordial germ cell (PGC) to completion of maturation, evidencing the hurdles encountered during this troubled journey. The female gamete is followed during its migration as a PGC towards the gonadal ridge (Mamsen *et al.*) and during its entry into meiosis (Spiller *et al.*), when, for the first time, we are able to read a whole genome transcriptional portrait of precious human PGCs in a comparative analysis with that of the mouse (Diedrichs *et al.*). Then, its growing phase in the adult ovary is described all through to the antral compartment, with a specific focus on metabolic changes (Collado-Fernandez *et al.*), the role of the Akt signalling pathway (Ceconi *et al.*) and the developmental relationship occurring between the oocyte and its companion theca, granulosa and cumulus cells within the antral follicle (Hennet and Combelles). During these stages of maturation, the oocyte acquires the zona pellucida, a glycoprotein layer crucial at the time of fertilisation, but, we learn here, also important for the growth of a healthy oocyte (Wassarman and Litscher). The long perdurance of the oocyte within the human ovary, maternal age, hormonal stimulation, disturbed metabolism, and depletion of the follicle pool contribute to mitochondrial dysfunction, spindle aberrations, and errors in chromosome segregation (Eichenlaub-Ritter).

As experienced by many couples that undergo assisted reproduction, not all the ovulated eggs are developmentally competent. What are the molecular hallmarks that make an egg developmentally competent is the question addressed in the following papers, the first of which analyses the potential role of an OCT4 transcriptional network in the acquisition of mouse oocyte developmental competence (Zuccotti *et al.*). The many gene networks involved in the functional regulation of oocyte maturation during folliculogenesis have required the development of tailored bioinformatic tools (Mulas *et al.*). The regulation of gene expression, when under epigenetic control, has been very recently better understood with the description of the CpG methylation profile throughout folliculogenesis (Tomizawa *et al.*) and the changes which chromatin organisation, histone acetylation and methylation profiles undergo (Bonnet-Garnier *et al.*), modifications that are important also for axial chromatid condensation and sister chromatid separation during meiosis progression (Yang *et al.*).

Most of these results have been obtained thanks to important technical improvements in the handling and culture of the female gamete and of the entire ovarian follicle. This Special Issue continues with the description of strategies adopted to culture human oocytes of patients undergoing artificial reproductive technologies (Telfer and McLaughlin; Coticchio *et al.*) or following cancer treatment (Combelles and Chateau), or mouse oocytes, including those designed with the aim of preserving the three-dimensional organisation of the follicle (Belli *et al.*).

In another Special Issue of the *International Journal of Developmental Biology*, Marc Mareel and Juan Aréchaga (*Int. J. Dev. Biol.* 48: 351-353, 2004) wrote that Oncology and Developmental Biology are two sides of the same coin as here highlighted in the interview with Ivan Damjanov. This is also the case for the female germ cell and the ovary into which it develops. Thus, we read on the fate of granulosa cells following premature oocyte loss and the development of ovarian cancers (Pitman *et al.*), of the involvement of the adipokines, AMPK, PI3K and PPAR signalling pathways in ovarian follicle development and cancers (Dupont *et al.*). Then, with a broader view, Nogales *et al.*, describe the relationship between ovarian teratoma and the development of gliomatosis peritonei.

This Special Issue ends with a contribution from Narbonne and Gurdon in which the study of development is undertaken with the visionary approach that has always characterised the research of Sir John Gurdon, a mentor for many young scientists, whose work has been awarded the 2012 Nobel Prize for Physiology or Medicine.

We hope the readers will enjoy the generous efforts of the colleagues who have contributed their papers. We express our gratitude to Juan (Aréchaga) who, thanks to his insightful vision, first stimulated this project and who has been a guide we could always trust on throughout; and last, but not least, our thanks to David J. Fogarty (Managing Editor) and the Editorial Team at the *International Journal of Developmental Biology*, who helped to keep us on track.

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