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INVITED EDITORIAL

Sperm Biology

The 12th International Symposium on Spermatology

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The 12th International Symposium of Spermatology continued the excellent tradition of this meeting since its inception in 1969 when the first Symposium was held in Italy under the Chairmanship of Professor Baccio Baccetti. This unique Symposium is held every 4 years and serves as a beacon for sperm cell biologists from all over the world, regardless of which species, animal or plant, they are working on. This willingness to embrace the fundamental biology of this distinctive cell type without species limitations is one of the hallmarks of this Symposium. For sperm biologists - it is our Olympics. The meeting in Newcastle, NSW brought together around 300 biologists from more than 22 different countries covering North and South America, Africa, Europe, Asia and Australia. Given the considerable distances and high cost involved in travelling to the East Coast of NSW, this was an outstanding outcome. The Symposium featured a series of 31 plenary lectures culminating in the prestigious Thaddeus Mann Memorial Lecture, which was delivered with typical grace and brilliance by Professor Masaru Okabe.

This Symposium volume published by the Asian Journal of Andrology (AJA) presents a selection of these keynote presentations and perfectly captures the current thinking in sperm cell biology across a wide range of species. Clearly the field is moving forward steadily under the influence of new analytical technologies which are generating novel insights into the composition and function of spermatozoa. Because spermatozoa are largely incapable of *de novo* gene transcription and contemporaneous protein translation, their biology is highly dependent on changes in their proteomic landscape mediated by myriad posttranslational modifications, including the acquisition or loss of entire proteins. Proteomic changes in the epididymis, for example, are central to our understanding of how spermatozoa metamorphose from the dysfunctional entities that exit the testes into one of the most sophisticated functionally-differentiated cells in biology. Proteomic changes are also central to our understanding of capacitation, the mysterious process by which spermatozoa regulate their maturation in the female tract so that they are finally ready to initiate their search for an oocyte and, having attained that goal, of then engaging in the complex cascade of cellular interactions that result in fertilization. Age-old questions around the capacity of spermatozoa to suddenly recognize the egg following capacitation are yielding to a range of technologies including advanced proteomics, proximity ligation assays and flow cytometry to generate vital information on the activation and surface expression of molecules involved in sperm–zona interaction.

The recent availability of instruments capable of the detailed resolution of proteomic profiles is also having a direct impact on our ability to understand the intricacies of chromatin remodelling during the final stages of spermiogenesis. These studies are helping us to resolve the very complex arrangement of protamines and histones in sperm chromatin that may ultimately influence patterns of gene expression in the early embryo. Of particular interest are reports that the proteins intimately associated with sperm DNA may themselves present a complex array of posttranslational modifications, including methylations and acetylations, which may constitute vital epigenetic information of relevance to the trajectory of early embryonic development. In similar fashion, the array of RNA species (including mRNA and miRNA) that are known to be associated with spermatozoa may constitute yet more epigenetic information with the potential to influence embryonic development and the health and wellbeing of the offspring. Furthermore, damage to the genetic integrity of sperm chromatin (including single and double strand breaks, abasic sites and oxidative base adducts) may also influence the development and future health of any progeny.

There is now a growing body of data revealing the vulnerability of sperm chromatin to oxidative attack and fragmentation. Such DNA damage has been associated with a growing inventory of diseases in the offspring, including a large number of neurological conditions (e.g., epilepsy, spontaneous schizophrenia, bipolar disease and autism) as well as cancers of blood and brain and metabolic disease. The widespread use of intracytoplasmic sperm injection as the default insemination technique in human ART, is of some concern in this context since DNA damaged spermatozoa are inevitably being used to achieve conceptions *in vivo* that would, for good biological reasons, have been prevented *in vivo*. While not inevitable, it is possible that such clinical practices will create a long-term health burden for our society, which future generations will have to solve.

The Spermatology Symposium also highlighted other technologies that are certain to improve our understanding of sperm cell biology including NMR (nuclear magnetic resonance), metabolomics and advanced flow cytometry allowing multiple probes to be assessed simultaneously or, in certain systems, coupled with image analysis. The recent advent of CRISPR technologies to facilitate the genetic modification of mice with greater efficacy than has been possible heretofore, is also likely to have a major impact on our ability to dissect the

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molecular underpinnings of sperm function.

The 12th International Symposium of Spermatology was a conference highlight, not just because the cell biology of spermatozoa is intrinsically interesting but also because of the enthusiastic participation of the attendees and a dedicated group of supporters that worked tirelessly to make the conference a success. In this context we should like to thank everyone who participated in the organization of the conference including Maree Overall, Angela DiSanto and Ben Curry as well as our sponsors including the University of Newcastle, NuSep, Oozoa and the NSW Government. I should also like to thank the Association of Applied Animal Andrologists (AAAA), particularly Steven Lorton and Peter Chenoweth, for partnering with the Spermatology Symposium to create an "Androfest" in Newcastle. This Symposium was, for us at least, the highlight of 2014. We cannot wait to reassemble in Stockholm in 4 years time to see what new things have been discovered about this endlessly fascinating cell.