

The Role of Centrioles in Mammalian Fertilization and Development

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Except for the mouse and several other rodents, in most mammalian species the sperm contains the centriole that serves as template for all centrioles during embryo development. After fertilization the radial sperm aster is nucleated and organized by the proximal sperm centriole while the distal centriole degenerates. The proximal centriole duplicates during the pronuclear stage and separates to the mitotic poles where it organizes the bipolar mitotic apparatus. In the oocyte, sperm recruits specific centrosomal proteins that are important for cell cycle-specific functions. The γ -tubulin ring complex nucleates microtubules while pericentrin plays a role in recruiting additional centrosomal proteins for sperm aster growth into the zygote aster following pronuclear apposition. The formation of the mitotic apparatus requires mitosis-specific centrosome proteins such as the Nuclear Mitotic Apparatus protein, NuMA. While not associated with the interphase centrosomes, NuMA is located in the nucleus during interphase and moves out of the nucleus to associate with microtubules after nuclear envelope breakdown (NEBD) for transport to the mitotic poles. It moves back into the nucleus and displays typical nuclear staining in nuclei of the divided daughter cells.

We have analyzed centrioles and centrosomes in several mammalian systems including the pig and mouse and find that infertility problems are directly associated with defective centrioles and an inability to accurately recruit centrosomal proteins for the formation of sperm aster and mitotic spindles [1-4]. The ability of sperm centriole defects to be carried into the developing embryo is based on the semiconservative mode of centriole duplication. After separation of the pair of centrioles, a new centriole grows from each of the individual centrioles to form a new set of centrioles. Abnormalities in centrioles and consequences for centrosome functions during fertilization and subsequent embryo development in several mammalian systems will be presented in the symposium.

References

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