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Sexual Dimorphism and Infertility

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Sexual dimorphism, the differences between the sexes, manifests distinct external appearances, internal processes, and behaviors in males and females. In sexually reproducing animals the gametes, sperm and eggs, exhibit perhaps the most critical sexual dimorphism as they allow for the propagation of a species. Gamete production has evolved to be a highly regulated process throughout the animal world. The gamete-forming germ cells follow differentiation programs but must also coordinate interactions with the somatic gonad, which nurtures germ cells throughout gamete development [1]. While research in fertility and reproduction has greatly advanced in recent decades, the molecular basis for many sterility disorders remains unknown. In cases, such as Klinefelter's syndrome and Turner's syndromes, sterility is thought to result from conflicting sexual identity in germ cells vs. the somatic gonad [2]. Using Drosophila melanogaster as a model system, we investigate the influence of germ cell sex on germ line-soma interactions.

In Drosophila melanogaster, the gonads are sexually dimorphic as they look morphologically different from each other. The gonads harbor two stem cell populations: one is germ line stem cells (GSCs), capable of producing offspring. The germ line stem cells are surrounded by the second stem cell set, the somatic stem cells. In Drosophila melanogaster, somatic stem cell population not only serves to nourish the germ line stem cells, but also signal to them. This ensures that sex of the germ line matches that of the soma and results in successful gametogenesis. The signal from male soma to male germ line was reported to be JAK/STAT signaling [3]. However how does this signal ensure male genetic program is turned on remains unexplored and elusive? The signal from female soma to female germ line is largely unknown and unexplored.

In Drosophila melanogaster, the sex switch gene Sex lethal (Sxl), regulates somatic sex determination [4]. The products of Sxl splices transformer (tra), which in turn splices Double sex (Dsx) this results in female sex. Sex-lethal does not seem to have a role in male somatic sex establishment. In the germ line, just like soma Sxl seems to play an essential role in female sex. Loss of Sxl in the germ line results in failure of differentiation and over proliferation of germ line stem cells. However, downstream components do not play a role in germ line sex determination. The elements that regulate Sxl in the germ line are largely unknown. Similarly, the downstream components below Sxl that regulate germ line sex determination are also unknown.

The sex-determining mechanisms are different in mammals and insects. The Y chromosome is essential in determining the male sex in mammals. In Drosophila, counting elements determine sex of the fly. The ratio of one or two X-chromosome to autosome results in male or female sex. We take an integrated approach to investigate how extrinsic signals from the soma combine with germ line intrinsic cues to initiate germ line sex determination and generate a sex-specific pattern of germ line gene expression. It will provide a comprehensive model for how sexual identity is established and used to influence important aspects of germ line development, such as the sex-specific formation of germ line stem cells. It can be used as a framework for continued studies of germ line sex determination in Drosophila and other animal species, including humans.

References

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