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The Ovarian Follicle Stage Distribution in C57 Mice Fed a High Fat Diet for 5, 10, 15-weeks

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Abstract

Reproductive lifespan and ovarian function in the mammalian female are dependent on the normal development of ovarian follicles. The total number of ovarian follicles are determined at birth and undergo development and ovulation following puberty. The quantification of ovarian follicles assists in facilitating viable fertility. A high-fat diet (HFD) can induce inflammation and disintegration of the structural integrity of follicular and ovarian tissue[1]. HFD-induced inflammation can potentially affect fertility levels in females by inducing changes in the distribution of ovarian follicles[2]. Follicles can be categorized into various types: primordial, primary, secondary, tertiary, Graafian and atretic. Beyond these classifications, follicles are grouped either as preantral including primordial, primary and secondary or antral including tertiary and Graafian. Through histology, we investigated the distribution of follicles after C57 female mice were fed a HFD for 5, 10, and 15-weeks in comparison to a control diet fed for the same durations. Overall, the purpose of our study is to determine how HFD-induced inflammation alters follicular distribution and impacts fertility.

Research Questions

- Is there a difference in the follicular distribution in control diet fed mice and HFD mice?
  - Is there adaptation that takes place if the HFD begins to affect development of follicles?
- What types of diet affect follicle viability? Besides diet, what factor constitute normal morphology and function of the ovary?
- How would follicles vary n HFD mice that have damaged ovaries?
- How do other conditions affect ovarian follicular distribution?
  - Endometriosis
  - Polycystic Ovarian Syndrome
  - Thyroid Stimulation
  - Synthetic reproductive hormones

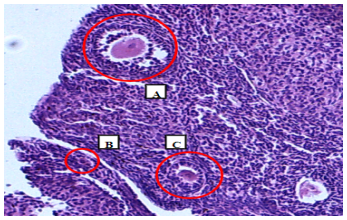
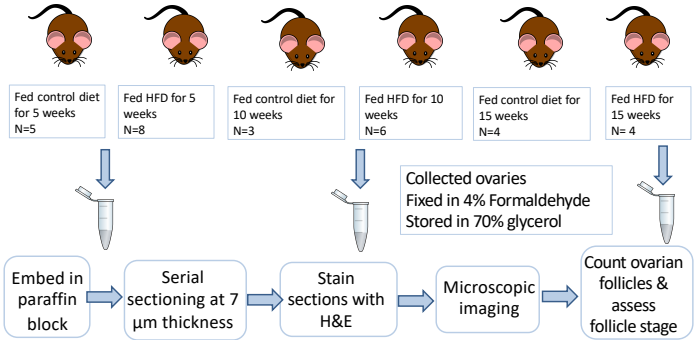


Figure 1: Follicle (A) contains an oocyte surrounded by multiple layers of granulosa cells and an emerging antral space, therefore classifying as a tertiary follicle. Follicle (B) contains an oocyte that is surrounded by a single layer of tight and compact cuboidal granulosa cells, therefore classifying as a primary follicle. Follicle (C) contains an oocyte that is surrounded by more than one layer of cuboidal granulosa cells with no visible antral space, therefore classifying as a secondary follicle.

Methods



Results

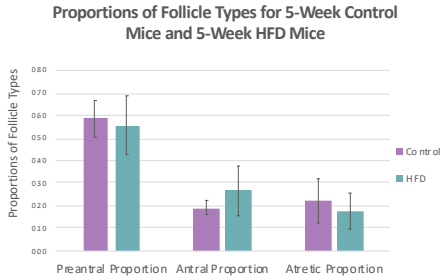


Figure 2. Proportions of follicle types for 5-week control mice and 5-week HFD mice. N=5 for control and N=8 for HFD. Control vs. HFD ANOVA: p=0.3876. Preantral post-hoc univariate ANOVA: F=0.1821, p=0.6778. Antral post-hoc univariate ANOVA: F=2.0392, p=0.1811. Atretic post-hoc univariate ANOVA: F=0.8441, p=0.3779

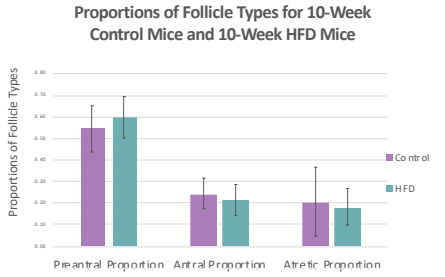


Figure 3. Proportions of follicle types for 10-week control mice and 10-week HFD mice. N=3 for control and N=6 for HFD. Control vs. HFD ANOVA: p=0.8954. Preantral post-hoc univariate ANOVA: F=0.5912, p=0.4671. Antral post-hoc univariate ANOVA: F=0.3656, p=0.5645. Atretic post-hoc univariate ANOVA: F=0.0897, p=0.7733

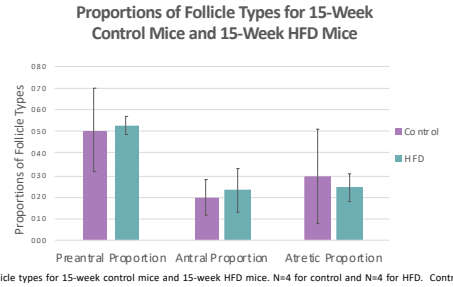


Figure 4. Proportions of follicle types for 15-week control mice and 15-week HFD mice. N=4 for control and N=4 for HFD. Control vs. HFD ANOVA: p=0.8537. Preantral post-hoc univariate ANOVA: F=0.0435, p=0.8417. Antral post-hoc univariate ANOVA: F=0.2443, p=0.6387. Atretic post-hoc univariate ANOVA: F=0.2181, p=0.657

Conclusions

There is no difference in the follicular distribution among the 5, 10, and 15-week control diet and HFD groups. An overall assessment of the preantral, antral and atretic proportions did not show a difference in follicular distribution. This could mean that 5, 10, and 15 weeks HFD did not induce sufficient weight gain to cause inflammation to the level that is detrimental to the development of follicular distribution. However, there is a possibility of a localized ovarian physiological adaptation that occurs along side weight gain associated with feeding a HFD. It is possible that this mechanism preserves the morphology and function of the ovary allowing normal follicular development.

Citations

1. Sohrabi, M., Roushandeh, A.M., Alizadeh, Z., Vahidinia, A., Vahabian, M., & Hosseini, M. (2015). Effect of a high fat diet on ovary morphology, in vitro development, in vitro fertilisation rate and oocyte quality in mice. *Singapore Med J 2015, 56*(10), 573-579. doi:10.11622/smedj.2015085
2. Skaznik-Wikiel, M.E., Polotsky, A.J., & McManaman, J.L. (2015). High-fat diet causes compromised fertility and increased pro-inflammatory cytokines independent of obesity. *Fertility and Sterility, 104*(3), E104. doi:10.1016/j.fertnstert.2015.07.321