Editorial

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The Oocyte and Its Role in Regulating Ovulation

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Ovulation rate in mammals is decided by a posh exchange of hormonal signals between the pituitary and therefore the ovary and by a localized exchange of hormones within ovarian follicles between the oocyte and its adjacent somatic cells. From examination of inherited patterns of ovulation rate in sheep, point mutations are identified in two oocyte-expressed genes, BMP15 (GDF9B) and GDF9. Animals heterozygous for any of these mutations have higher ovulation rates (that is, + 0.8–3) than wild-type contemporaries, whereas those homozygous for each of these mutations are sterile with ovarian follicular development disrupted during the prenatal growth stages. Both GDF9 and BMP15 proteins are present in follicular fluid, indicating that they're secreted products.

In vitro studies show that granulose and/or cumulus cells are an important target for both growth factors. In summary, recent studies of genetic mutations in sheep highlight the importance of oocyte-secreted factors in regulating ovulation rate, and these discoveries may help to elucidate why some mammals have a predisposition to supply two or more offspring instead of one. Ovulation rate in mammals is decided by a posh exchange of hormone signals between the pituitary and therefore the ovary, and by a localized exchange of hormones within ovarian follicles between the oocyte and its adjacent somatic cells.

From examination of inherited patterns of ovulation rate in sheep, several breeds are identified with mutations in two protein genes that are expressed in oocytes, namely, bone morphogenetic protein 15 (BMP15), also referred to as growth differentiation factor 9B (GDF9B), and GDF9. BMP15 and GDF9 are two closely related members of the reworking growth factor-β (TGFβ) superfamily, many of which are important for regulating ovarian follicular development. However, what distinguishes BMP15 and GDF9 from other TGFβ superfamily members is that changing concentrations of those two factors in vivo results in incremental changes in ovulation rate in sheep. The significance of those discoveries is that the oocyte appears to manage the expansion and differentiation of adjacent somatic cells also as their responsiveness to endocrine signals and thereby the amount of follicles that mature and ovulate.

The mean ovulation rates of F700 Bellaire, Cambridge, Hanna and Inver dale ewes heterozygous for the known BMP15 and GDF9 mutations, together with the effects of the mutations on the BMP15 or GDF9 protein or their possible interactions with a type I or II binding domain, are summarized in Animals with a likely 50% reduction in intrafollicular concentrations of BMP15 (FecXG, FecXH or FecXI) have a mean ovulation rate increase of 35–67%, whereas animals heterozygous for a mutation in the region of BMP15 or GDF9 that interacts with a type I or II receptor (FecXB or FecGH) have mean ovulation rate increases of 87–95%. The mean ovulation rates in Lacunae ewes, heterozygous for the BMP15 mutation leading to a tyrosine substituting for a cysteine at mature peptide residue 53, is not known, as carrier animals currently identified have another co-dominant mutation on chromosome 11.

